

City Resilience Strategy

SEMARANG's adaptation plan in responding to climate change



Asian Cities Climate Change Resilience Network (ACCCRN)

2010

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This document is a plan for Semarang City in order to adapt to the pressures and shocks that may occur as a result of climate change. This document is not exclusive in the context of planning for the city because its formulation and format has been synergized with the substances of Semarang's Medium Term Development Plan (RPJM). The final section of this document can be an inspiration for agencies in Semarang City about how they can contribute to climate change adaptation activities. This document is not a static document as this can be quickly adjusted with additional scenarios that may occur.

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1. Introduction

1.1. Background

A significant changing on the climate system that we presently experience is not only an argument. Some evidence from observation and studies mainly conducted by the International Panel for Climate Change (IPCC) has shown that increasing air and ocean temperatures, melting snow and ice, and an increase in sea level is real. UNEP (2009) has published a document that summarizes the important studies and the latest information from the IPCC on global climate change.

It is no doubt that climate change is happening right now as a result of human activity. However the most significant human activity is the activity within the last 50 years all over the world. In that period, natural causes such as solar radiation does contribute in increasing the temperature of the earth's atmosphere. Unfortunately, scientific evidence shows that human activity is the major contributors in comparison with natural causes and they should be responsible for global warming (IPCC within UNEP, 2009). This warming is not only related to temperature but also causes extreme changes in other aspects that have effects on humans.

As it has been shown in the Vulnerability Assessment, global warming is a real phenomenon in Semarang City. Based on two scenarios, the city's temperature showed an increasing trend so did the seawater elevation. Changes in temperature also create opportunities for change in the intensity of precipitation, especially during the rainy season, which is predicted to increase. This extreme climate change can contribute to the occurrence of floods in Semarang City. Meanwhile, sea level rise will exacerbate flooding problems and seawater inundation that already exist.

Besides flood and inundation as one of the most obvious form of climate change in Semarang City, it has also been confirmed that climate change also increases the risk of landslides, drought, and abrasion in a number of areas in the city.

These catastrophic events, in a large scale, lead to a concern that it might affect the sustainability of city development. In a smaller scale, the impact of climate change can happen on the community groups in particular areas of the city, especially the poor and marginalized groups.

Asian Cities Climate Change Resilience Network (ACCCRN) in Semarang City has exceeded a number of milestone achievements. These achievements begin with the completion of vulnerability assessment (VA), implementation of pilot projects for climate change adaptation and sector studies. Prior to the implementation of climate change adaptation in the city scale, all these achievements are very important to be studied more in depth and followed up through the preparation of City Resilience Strategy (CRS). Therefore, the CRS document within the ACCCRN framework is a basic foundation for the future intervention projects and activities to increase Semarang City's resilience to climate change.

Rockefeller and ISET (2010) define resilience as the ability of a system to withstand from any pressures and shocks and a system's ability to maintain its function. The city is a system that must be made resistant (resilience). Resilience and adaptation are very important because of the vulnerability of urban systems. As a system, the city consists of several regions (sub- systems) that each of them has different functions and elements. As a system, each sub-system was connected to each other and together creates a functioning city. An extreme damage to one of the sub-urban system or one part of urban areas will be able to affect other sub-systems, even the overall system. Basically, A resilient system is expected to maintain the resilience of the city's main functions of the various forms of pressure and shock resulting from the impacts of climate change. The resilient system also allows the city to make a quick recovery from such impact.

From practical perspective, CRS document can also be viewed as a roadmap to prepare the city in dealing with the worst scenario which may arise from climate change. Without the resilience strategy document, the functions of urban systems and vulnerable group will be threatened.

1.2. Goal

The purpose of the CRS document of Semarang City is to produce a number of strategies to cope with climate change impacts that will be integrated into urban development policy.

1.3. Objectives

To produce the above strategy, the following are a number of targets to be achieved:

1. Identifying the existing conditions of climate change impacts, vulnerability, and vulnerable groups in Semarang City
2. Developing urban development and climate change scenario and their consequences on the future
3. Formulating resilience strategies at city level in a multi-dimensional perspective
4. Translating strategies into several adaptation actions to enhance resilience
5. Prioritizing adaptation activities and preparing draft proposal of the prioritized actions.

1.4. Scope of Planning

The coverage of city resilience strategy (CRS) will include:

First, a review on the results of studies of climate change impacts and vulnerability (VA) of Semarang City. The review would be sharpened by further discussion on current issues of city planning and development, which is dynamics and keep changing. Therefore, the review of climate change and vulnerability will be focussed continue to see its relevance to current issues and emerging development plan in the city of Semarang.

Second, formulating a series of resilience actions or intervention strategies. This is the most important part of the whole process. In this formulation, every single actions will be assessed: (a) their contribution qualitatively or quantitatively in creating resilience of the city, (b) their benefits for

vulnerable groups, (c) the role of government and stakeholders to support, and (d) their association with other activities.

Third, prioritization of intervention strategies and resilience actions. The prioritization includes a comparison of every single the activities or strategies with a set of agreed prioritization criteria. The strategies and actions that have been prioritized is equipped with a draft proposal and their monitoring and evaluation mechanisms. Table 1.1 below will give a systematic explanation of the scope of CRS document preparation.

Table 1.1: CRS Document Scope

Scope 1:	Scope 2:	Scope 3:	Scope 4:
Review of Climate Impacts Assessment and Vulnerability	Strategy Formulation & Proposed Action Plans	Prioritization of Action plans	Annex Draft Proposal
Synthesis document's ACCCRN (VA, CBVA, Sector Studies, Pilot)	Development of climate and city scenarios	Development of prioritization criteria	Outline budget of the prioritized activities
Additional issues of SLDs	Produce the series of activities to create resilience	Comparative analysis of the proposed activities	Preparation of timeline
The actual and dynamic issues in urban development	Assess the contribution the proposed activities	Identify of complementary activities and actors	Establishment of a leading agency /sector
Supporting studies	Identify benefits for vulnerable groups	Development of M &E mechanisms	
	Role of stakeholders		

Source: Rockefeller Foundation and ISET (2010)

1.5. City Resilience Strategy Planning Stages

The methodology developed in the preparation of CRS document in Semarang City is not different from the method that has been developed by the Rockefeller Foundation and ISET (2010). However,

a little simplification was applied to adjust with the development planning process and realities that took place locally. Firstly, the process began with the preparation phase and was followed by brainstorming stage. The next stage was consultation and prioritization. Finally, the stage was ended up with the preparation of documents and draft proposals. The general approach in the preparation of the CRS of Semarang can be explained as follows:

1.5.1. Preparation.

This stage is similar to 'plan for planning'. This phase includes efforts to bridge the gap of perception and knowledge among the City Working Group (CWG) and between CWG and the Technical Team (City Team) on ClimateChange Adaptation of Semarang. Besides, this early stage also begins with the gathering of support and synchronization with the preparation of City's Mid-term Development Plan 2010-2014.

This activity is conducted through a workshop to conduct a comprehensive review on the results of: (1) SLD; (2) VA, (3) Sector Studies and (4) lesson learn from the Pilot Projects. Besides, the workshop also examines the trend of development and urban planning that will affect on the adaptation strategies and actions. The participant of this workshop was CWG and City Team. This workshop also introduced the participant about the city resilience concept and practice and its formulation process.

From this workshop the knowledge gap between the CWG and the city team was minimized and the contribution of each party in CRS preparation context was clarified. At this stage, communication and coordination with the City Mid- term Development Plan's drafting team was also conducted through several of informal workshops meeting.

1.5.2. Brainstorming

The second activity is an activity that is dedicated to develop resilience strategies. In general, city resilience can be achieved by various activities adaptation, both physically or non physically and of various dimensions such as infrastructure, environmental, socio-economic, or institutional. However, to be relevant and have a strong base, the formulation of adaptation strategies and actions should be based on the results of climate scenarios. Therefore, the activity is manifested in a series of

brainstorming workshops. In the first series, the aim of workshop was to develop climate scenarios. The scenario was linked with the tendency of urban development in Semarang City. The second series, the workshop aimed to formulate a strategy and action in multi- sector resilience based on previous generated urban and climate scenarios.

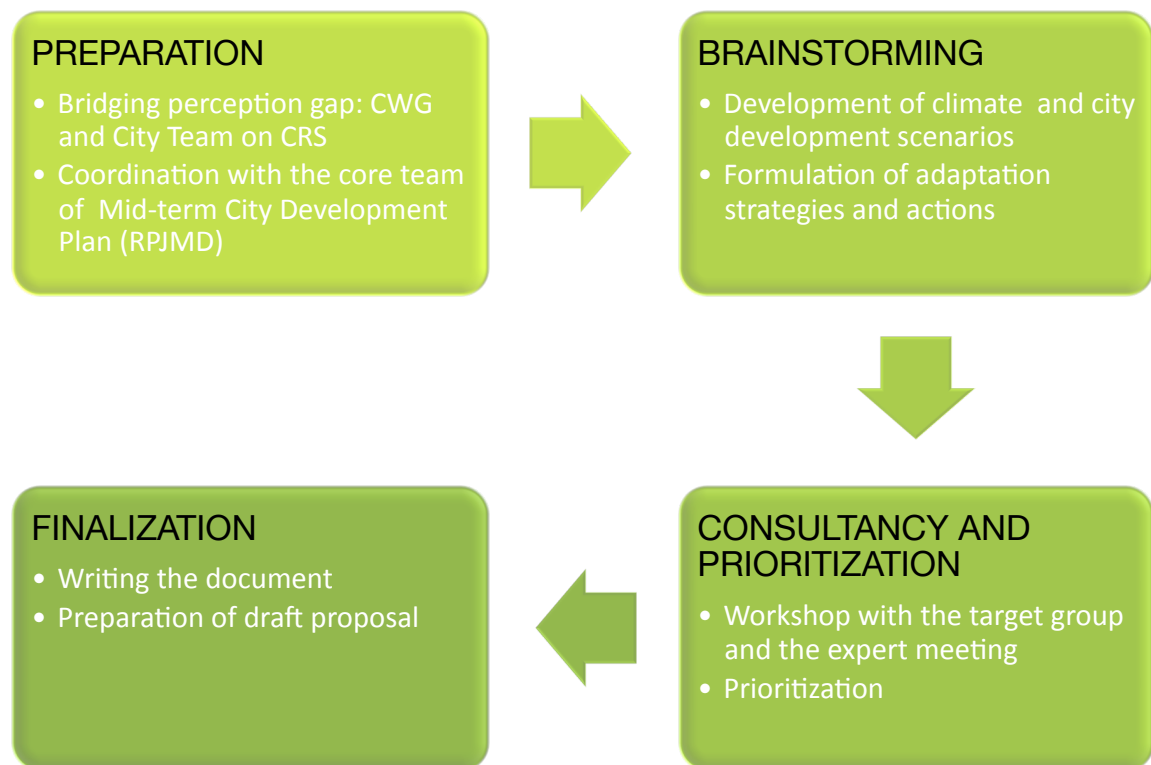
1.5.3. Consultation and Prioritization

The third activity, consultation and prioritization, is intended to verify the formulated adaptation strategies and actions to improve city resilience. This phase also included several workshops. In prioritizing the adaptation strategies to climate change, Qualitative Methods Cost and Benefit Analysis was applied. Besides, this stage is also intended to gain legitimacy from the target groups and to get a further operational input from expert in each prioritized strategies or actions.

1.5.4. Finalization of City Resilience Strategy Document

This phase is the last technical activities within the CRS preparation framework in Semarang City. The proposed strategies and action to resilience is integrated with the normative mid-term development planning documents (RPJMD) in term of its format or association with other grand strategy in the normative document. The proposed strategies and actions consider their consistency with other documents (such as RTRW City). It is expected that the CRS document does not collide each other and then can be used by government agencies in the translating the CRS into of annual activities. In finalizing this draft proposal also included the preparation of a strategy or action adaptation increased durability. In this stage, a concept proposal of prioritized strategies and actions is developed as a complement of CRS document. The concept proposal can be detailed as a proposal that may be filed by various parties involved in the preparation of the CRS to local government, central, and international donors. The concept proposal will include prioritized activities, budget requirements, timeline or work schedule, and responsible parties (PIC). Thus, resilience strategy will consist of a series adaptation of action and come with priority adaptation action proposals. And no less important, urban resilience strategy is a document that can connect and coordinate additional activities to donor funding. From the above explanation, the stages of preparation of the CRS in the city of Semarang can be illustrated in Figure 1.1 below.

Figure 1.1: Approach to Development of CRS in Semarang City



1.6. The CRS Document Organization

The CRS document of Semarang City consists of 6 Chapters. After this introduction the second chapter contains the description of Semarang vulnerability to climate change in which would include climate change scenarios in the city, its impact on the internal system of the city, and description of vulnerable groups. Furthermore, the third chapter of this report will describe the direction and policy development within the city that includes the existing policy in response to climate change impacts and issues of actual and dynamics of development as the basis for the development of Semarang city scenario.

The fourth chapter describes the development of climate scenarios and scenario development of Semarang. From the development of this scenario, a synthesis process is conducted to determine

sectoral coverage of issues related to climate change in the city of Semarang. The fifth chapter contains the translation of resilience strategies and actions derived from the development scenarios. The detailed elaboration of proposed strategies and actions are grouped by related sectors and followed by prioritization. The last chapter contains a framework for implementation and monitoring and evaluation of the proposed resilience strategies and actions.

2. Semarang City's Vulnerability

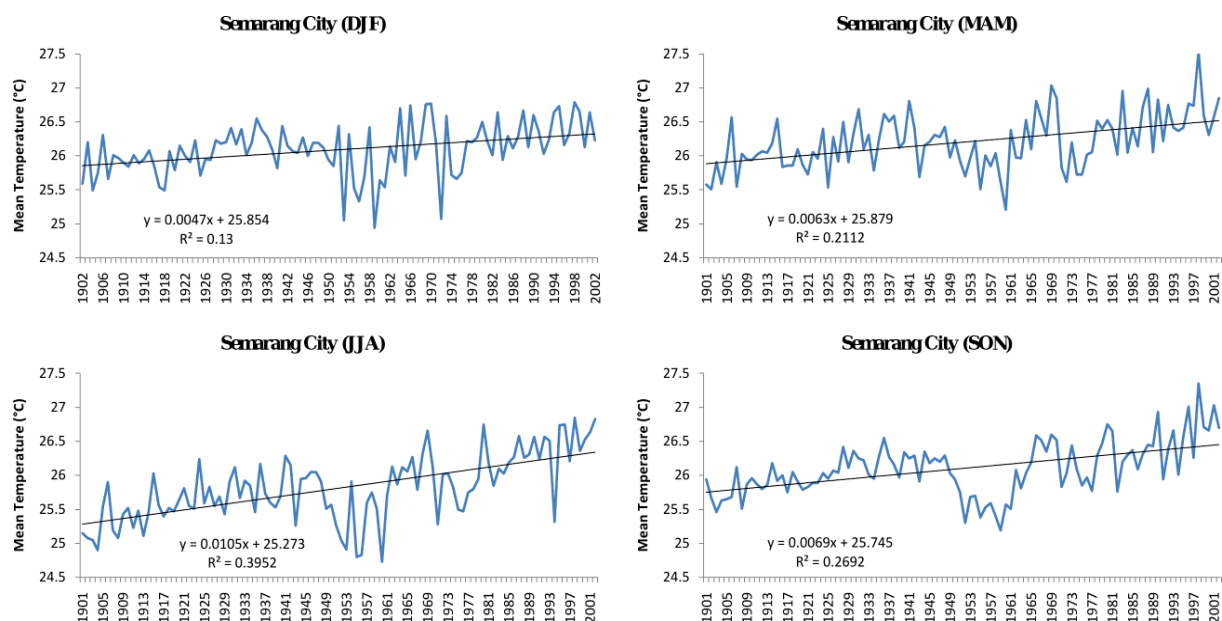
2.1. Climate Change Trend in Semarang City

Climate change trend in Semarang will be evaluated from some climate features such as temperature, rainfall, seawater elevation, and wind patterns. This trend is based on the vulnerability assessment (VA) report and it is also supported from climate change studies in the north coastline of Java (DKP, 2008).

2.1.1. Temperature

Based on the CRU TS2.0 temperature data extracted for Semarang, CCROM-IPB (2010) found the increasing trend of mean temperature in each season in the last 100 years (Figure 2.1). In the wet season (DJF), the mean temperature increased from 25.9 to 26.3 C, while in the dry season (JJA) it increased from 25.3 to 26.3 C.

Figure 2.1: Average Temperature in Semarang City 1902-2002 (CCROM-IPB, 2010: 44)



The increasing trend is also related to the presence of increase in daily maximum temperature trends (Figure 2.2). In the wet season (DJF) the maximum temperature increased from 31.4-31.9 C; while in the dry season it increase from 31.2 to 32.2 C. In addition, it is found that the daily temperature range (DTR) showed a downward trend (Figure 2.3) indicating that the increase of daily minimum temperature is more rapidly occurred than the maximum temperature.

Figure 2.2: Average of Maximum Temperature in Semarang City 1902-2002 (CCROM-IPB, 2010: 45)

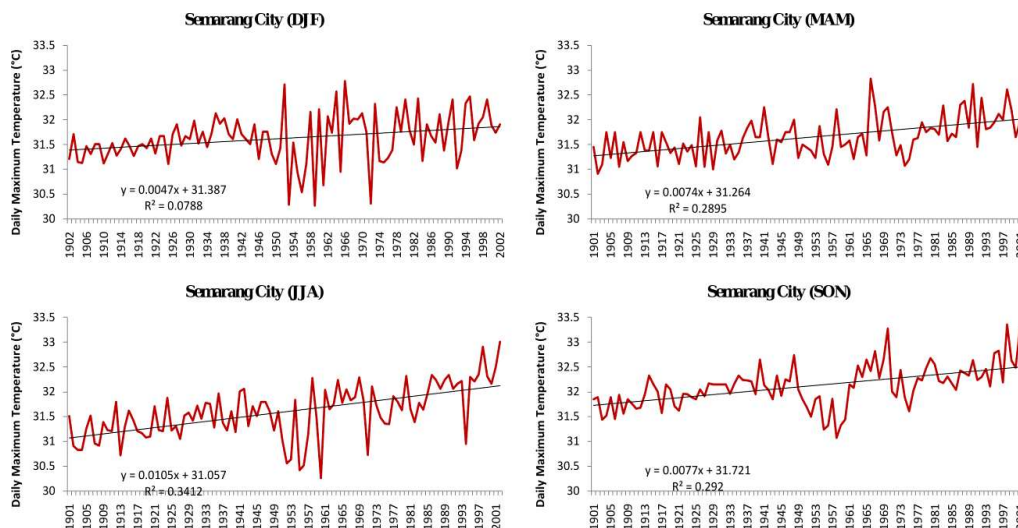


Figure 2.3: The Decreasing Trend of DTR (Daily Temperature Range) in Semarang (CCROM-IPB, 2010: 42)

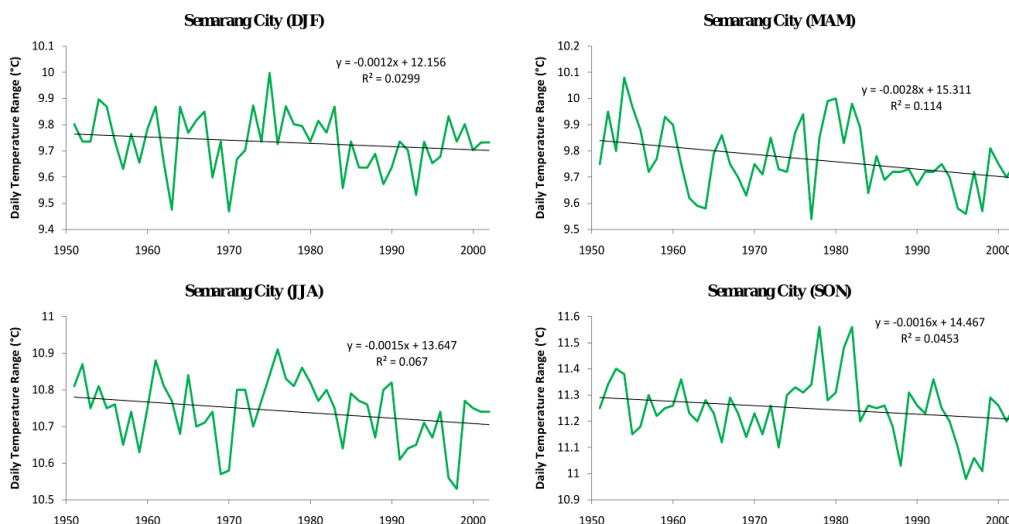
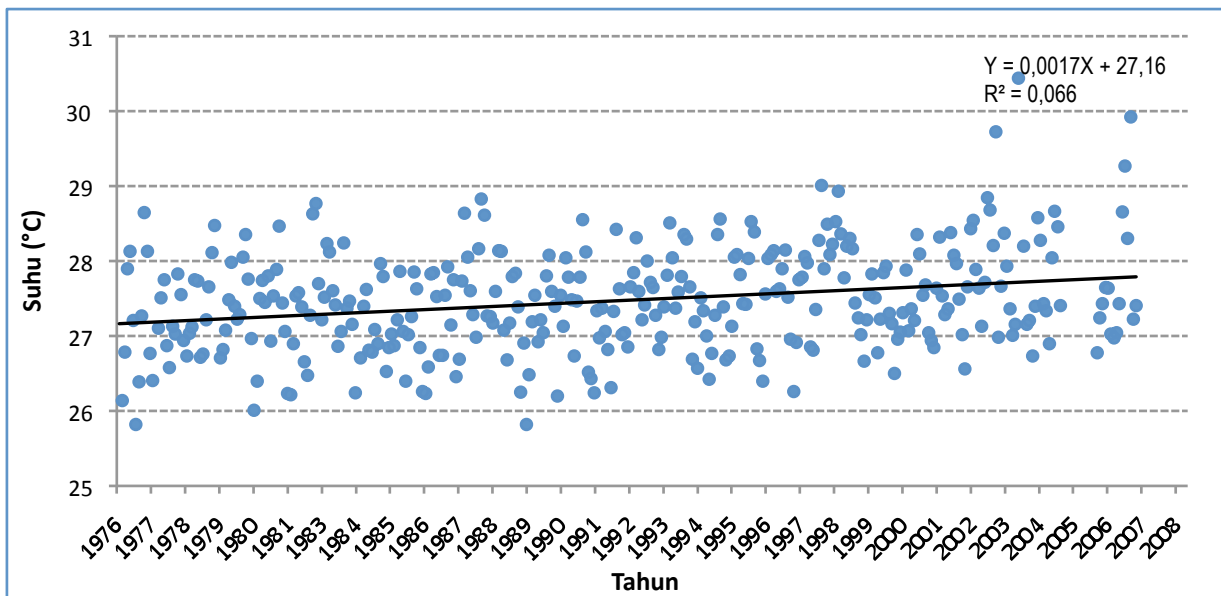


Figure 2.4: The Increasing Trend of Temperature in Semarang City (DKP, 2008)

Another study from DKP (2008) shown that in the last 30 years, the monthly average temperature in the Semarang Region can be seen in Figure 2.4. The figure shows that monthly average temperature from 1977 to 2007 increased slightly and quite significant. Linear equations obtained from the graph is $Y = 0.0017 X + 27.16$ (where x = month x starting from January 1977). From this equation it can be seen that the increase in average monthly temperature for 3 last decade is about 0.62 C or 0.02 C annually. Changes in air temperature in the Semarang Region is expected to increase, even for 100 years prediction air temperature in this region will rise 2.7 C from 2007 temperature.

Meanwhile, studies conducted by CCROM-IPB (2010) mentions that the increase in temperature is estimated to range between 0.5-0.7 C in 2025; between 1.1-1.2 C in 2050, and between 1.9-2.9 C in 2100. These prediction are relative to temperature in 2002. There is a bit difference between in the analysis of temperature change scenarios. Changes in temperature as indicated on the following table will lead some others changes in precipitation intensity, especially during the rainy season which is predicted to increase.

Table 2.1: Temperature Scenario in Semarang City (CCROM IPB, 2010)

	2000	2025	2050	2100
SRESA2: moderate	0.2	0.5	1.2	2.9
Range	0.15-0.25	0.3-0.7	0.8-1.6	2.0-4.1
SRESB1: moderate	0.2	0.7	1.1	1.9
Range	0.15-0.25	0.5-0.9	0.7-1.6	1.2-2.27

2.1.2. Rainfall

Based on 100 years rainfall CRU TS2.0 dataset, it is known that rainfall in Semarang City and number of rainy days is very volatile. However, in general it is known that rainfall increased in its intensity on the wet season (SON and DJF). In DJF, the seasonal rainfall increased approximately from 950 to 1000 mm, while in SON it increased from 250 to 300 mm (see figure 2.5). The upward trends of rainfall during wet seasons (SON and DJF) are associated with increasing trends of wet days frequency at the same seasons, from 44 to 47 days in SON and from 67 to 68 days in DJF (see figure 2.6). This indicates that the increasing rainfall during 20th century over Semarang city is caused by the rains that came more often, raising the probability of floods in the region.

In contrast, a downward trend appears in dry season (MAM), indicating a decrease of wet days frequency from 70 to 67 days that is associated with greater chance of dry season that comes earlier (see figure 2.5 and 2.6). For the wet days frequency during JJA, the trend seems to be relatively flat at 40 days with a slight increase.

CCROM-IPB (2010) also provides threshold analysis of rainfall of Semarang City and concluded that the flooding would occur if rainfall is 302 mm or above, while drought will happen if rainfall is less than 84 mm. Unfortunately, a future projection on rainfall and the number of wet days is not available in Semarang City. This report then assumed that the dry season will increase one month longer than the trend and the rainy season will increase up to 2 months longer than the current trend.

Figure 2.5: Trends of Seasonal Rainfall in Semarang City (CCROM IPB, 2010: 42)

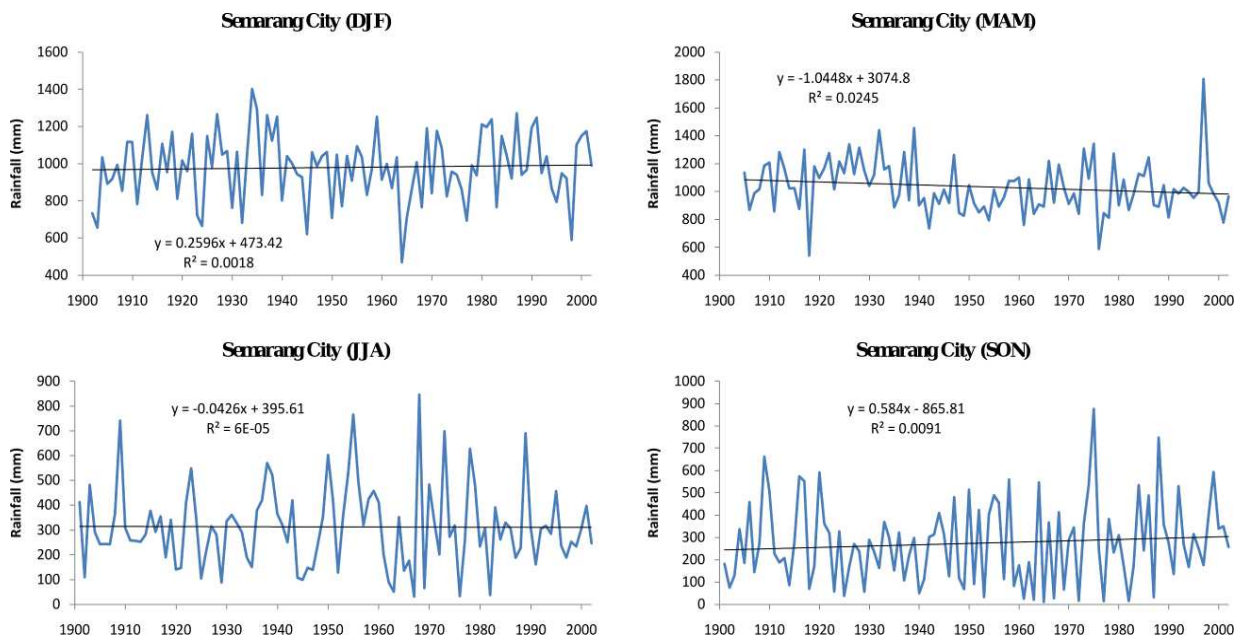
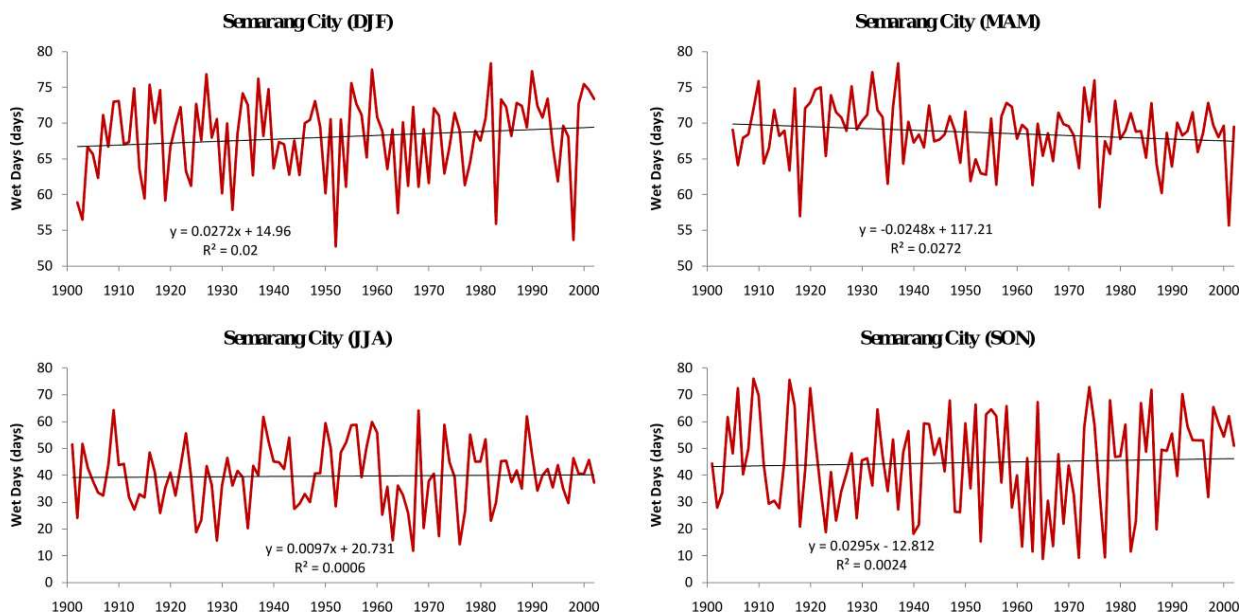


Figure 2.6: Trends of Seasonal Wet Days Frequency in Semarang City (CCROM, 2010: 43)

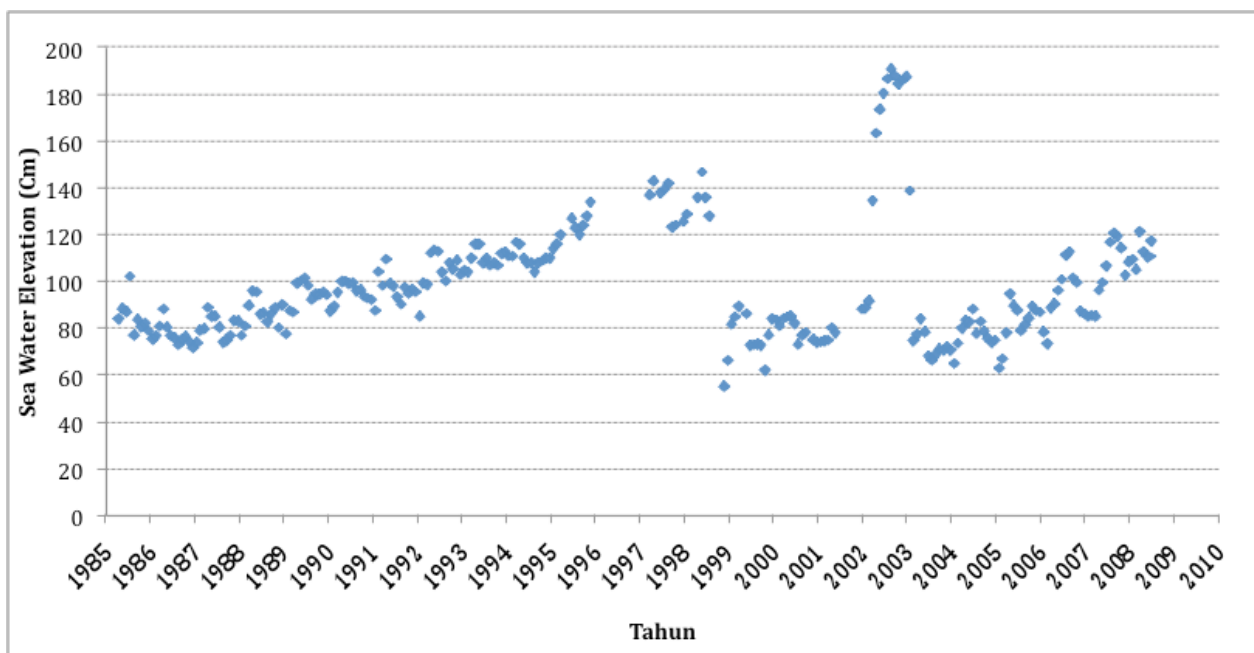


2.1.3. Increase in Sea Level Rise

The elevation of Semarang seawater continued to rise from 1985 until the year 2008 (Figure 2.7). Sea level rise in Semarang Coast from the year 1985-1998 is 58.2 cm, with an average annual sea level rise at 4.47 cm/ year (DKP, 2008). Later in the year 1998-2003 sea level decreased. But the declining in sea level that occurred from the years 1998-2003 are considered not valid due to the instrument failure (DKP, 2008). Based on water level data from year 2003-2008 it was known that sea level trend turned high again (Figure 2.7). While for sea level rise in Semarang waters year 2003 -2008 is 37.2 cm, the average sea level rise per year is 7.43 cm/ year (DKP, 2008).

In order to know the level of sea level rise due to the influence of global warming in Semarang, the difference between the rise sea water with a total value of land subsidence on the location of tidal stations were calculated. Data of sea level elevation sea years 1985-1998 and 2003-2008 were used. The calculation of sea level rise due to global warming by considering the reduction of land subsidence is about 5.165 cm/ year, so rising sea levels due to global warming is about 7.8 mm/year.

Figure 2.7: Sea Elevation in Semarang City 1985-2008



Source: Bakosurtanal Data analyzed by DKP (2008)

Meanwhile, the vulnerability assessment (VA) estimates that the average increase in sea level elevation will approximately at 21 cm in 2050, and 48-60 cm in 2100. Here is a table of climate change scenarios obtained previously from the VA in Semarang City (CCROM IPB, 2010).

Table 2.2: Sea Level Rise Scenario in Semarang City (CCROM IPB, 2010)

	2000	2025	2050	2100
SRESA2: moderate	2	10	21	60
Range	0-4	4-20	9-41	15-112
SRESB1: moderate	2	10	21	48
Range	0-4	4-22	9-42	18-85

Source: CCROM-IPB (2010)

Estimation made by DKP slightly more pessimistic than the estimation of CCROM-IPB, with the SLR difference about 20 cm in 100 years to come. However, DKP provides more complete spatial analysis information about the consequences of such changes. With the estimated level rise sea water of 0.8 m for the next 100 years, the estimated sea water inundation in Semarang City will reach distances ranging from 1.7-3.0 km to the ground, where the total inundated area will up to 8537.9 ha.

Figure 2.8 (a): Sea Water Inundation in Semarang City in The Next 100 Years with SLR Estimation at 80 cm



Figure 2.8 (a) shows a simulation of sea water inundation over next 100 years in Semarang City. The dark blue color in the eastern and western part of city represents 20 cm inundation. The dark blue color becomes lighter overtime. The lightest represents 80 cm inundation. The blue gradation in between represents 40 cm and 60 cm sea water inundation

Figure 2.8 (b): Sea Water Inundation in Semarang City in the Next 100 Years with SLR Estimation at 80 cm



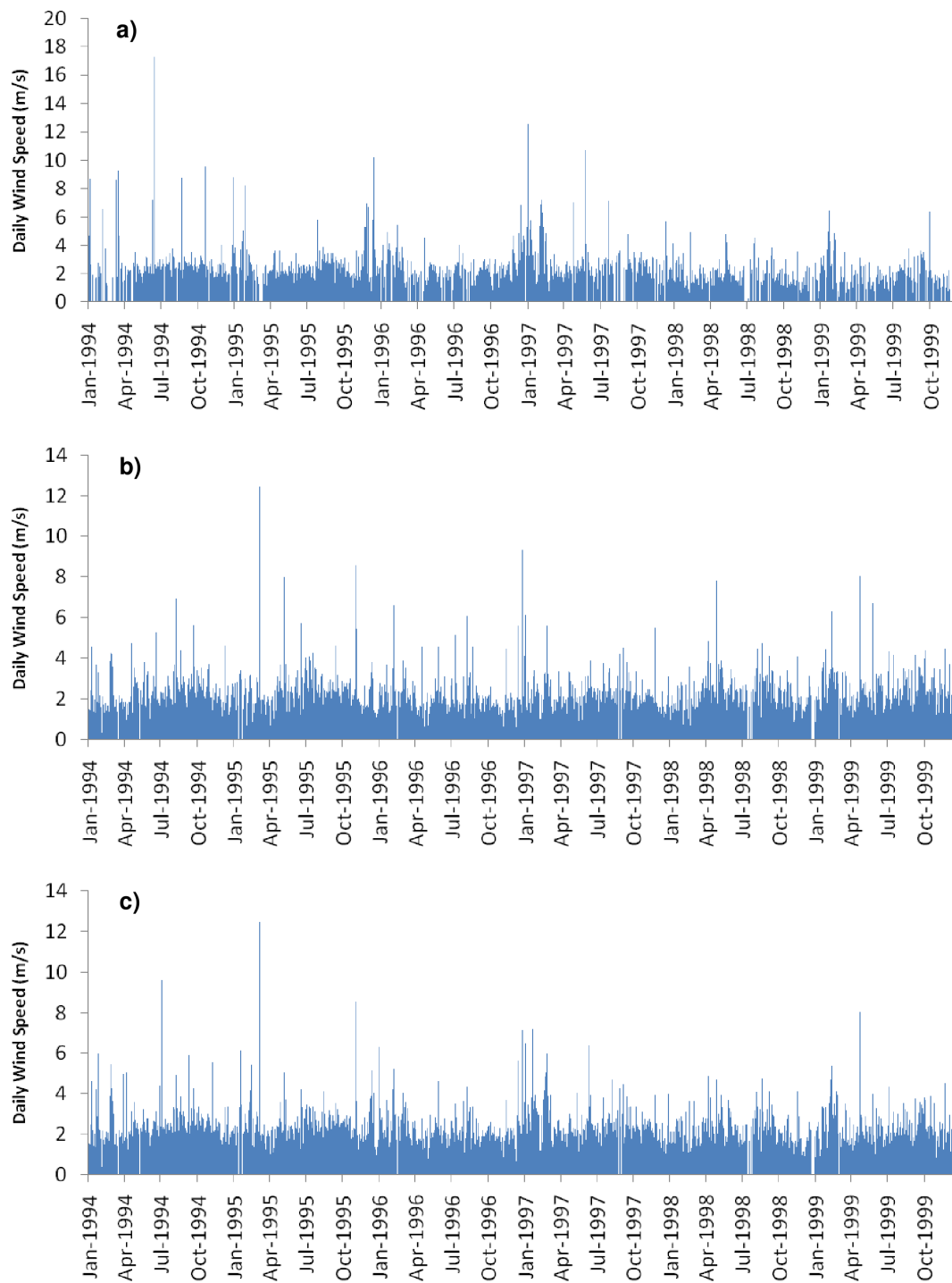
Figure 2.8 (b) illustrates the projections of the range of pressure from sea level rise to Semarang City areas. The range is between 1.7 km (the shortest) in the north eastern part of city and 3.2 km (the furthest) in the northern of Semarang.

Source: DKP (2008)

2.1.4. Wind Pattern

Study of DKP (2008) mentioned that the average distribution of wind direction in Semarang City from 1977 to 2008 was not dominated by a particular direction because the percentage wind distribution is almost the same (for wind direction mostly from the Northwest, North, East and Southeast). The wind speeds from 1980 to 2008 ranged between 1-3 m / s (75.2%). In addition, DKP (2008) divides the season in Semarang City into 4 seasons, namely West season, Transition season 1, East season and Transitional season 2. During the West season the domination of wind coming from the west-northwest direction and with speeds between 1-3 m/sec (70%). In Transition season 1, the largest direction of the wind coming from the North, East and Southeast with the average wind speeds between 1-3 m / s (70.7%).

Figure 2.9: Data of Wind Speed in Semarang City 1994-1999 (CCROM IPB, 2010)



Source: CC-ROM, 2010: 39

In East season, the domination of winds blow from the East and Southeast. Wind blowing to eastward is faster than the wind that comes from Southeast direction. The average wind speed is vary between 1-3 m/ s (77.9%). In transition season 2, the condition is almost the same with transition season 1, however the largest distribution of the wind coming from four directions namely North West, North, East and Southeast. The range of average wind speeds at 1-3 m / s (78.4%). In general there are no significant changes in term of wind patterns in Semarang City, where the domination of winds direction from the year 1977-2008 is from the East and Southeast.

Besides the influence of extreme climatic events caused by climate variability between years, the Semarang City is also influenced by extreme weather conditions, like high winds. Based on data record collected daily from the weather station and Ahmad Yani Airport in Semarang, CCROM IPB (2010) states that the extreme wind speeds tend to occur locally (Figure 2.9). At the Semarang station, extreme wind speed above 60 km / h (17.2 m / s or 62 km / h) occurred on June 15, 1994, while the highest wind speed at station Ahmad Yani Airport occurred at 5 March 1995 (12.5 m / s or 45 km / h).

2.2. Vulnerable Areas and Its Impact

Community vulnerability assessment which has been done previously also indicated a number of characteristics of vulnerable areas in Semarang City. Vulnerable areas and its possible impacts can be grouped as follows (Mercy Corps, 2009):

1. Lowland regions which are exposed to coastal flood and sea level rise
2. Settlement areas located in riverbed which are exposed to flooding
3. Hilly areas which are exposed to high winds
4. Areas which is exposed to land movement and landslides
5. Neighborhood residential areas on the city outskirts which far away from water sources

In addition to above categories, there are other areas that are important to consider as a vulnerable area since they have a broad impact on Semarang City. These categories include (Setiadi and Kunarso, 2009):

6. Areas as a node of movement (Such as airports, seaports, train stations, and terminal)
7. Functional central business district (with emphasis on the areas of business, trade and industry)
8. Historical area and cultural assets (old town area of Semarang)

The following is the explanation of each categorization of the above vulnerable areas .

2.2.1. Lowland Regions which are Exposed to Coastal Flood and SLR

Neighborhood residential located in coastal areas which are threatened by inundation as a result of sea level rise have nearly 300 thousand inhabitants. It is estimated that the total area which will be flooded is approximately 7,500 hectares. The following table presents sub-districts and the total area in each district that will be flooded due to sea level rise:

Table 2.3: Estimation of Residential Areas that will be Flooded by SLR

District	Sub-District	Area (Ha)	% Area of District
Genuk	Trimulyo, Terboyo Wetan, Terboyo Kulon, Muktiharjo Lor, Genuksari, Gebangsari, Bangetayu Kulon	1892.4	1.65
Tugu	Mangkang Kulon, Mangunharjo, Jerakah, Tugurejo	1952.1	0.56
Semarang Utara	Panggung Lor, Panggung Kidul, Bulu Lor, Purwosari, Plombokan, Bandatharjo, Kuningan, Dadapsari, Tanjung Emas, Plombokan, Panggung Kidul,	1481.2	4.95
Semarang Barat	Karang Ayu, Tawang Sari, Tawang Mas, Gisikdrono, Krobokan, Tambakharjo, Krobokan,	1287.1	2.22
Gayamsari	Kaligawe, Tambak Rejo, Sawah Besar	257.3	0.98
Semarang Timur	Kemijen, Mlatibaru	184.7	0.23

District	Sub-District	Area (Ha)	% Area of District
Pedurungan	Muktiharjo Lor, Muktiharjo Kidul	431.7	0.12
Semarang Tengah	Pandansari, Purwodinatan	280.1	0.13
	TOTAL	7487	10.85

Source: Setiadi and Kunarso (2009).

Similarly, fishpond areas in Semarang City will be flooded as a result of sea level rise. 44.5 hectares of fishpond areas in Semarang City is expected to have stagnant water. It is also possible that the fisheries sector of Semarang City will experience a decline in production. The decrease of production in the fisheries sector will have a derivative impact on population livelihood especially fish farmers. Today approximately 2,500 inhabitants (not including dependent family members) who have livelihoods as fish farmers would be threatened with losing their jobs in the future. Information on the number of people displaced due to sea level rise are not available. However, migration data in the last five years showed a decreasing number of net migration in the inundated areas.

Figure 2.10: Net Migration in Coastal Areas (Year 2003-5 and 2007-8)

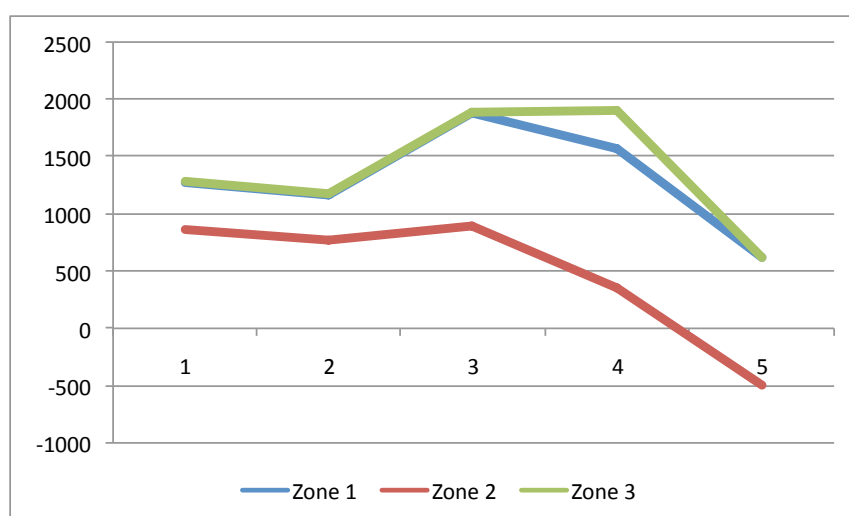
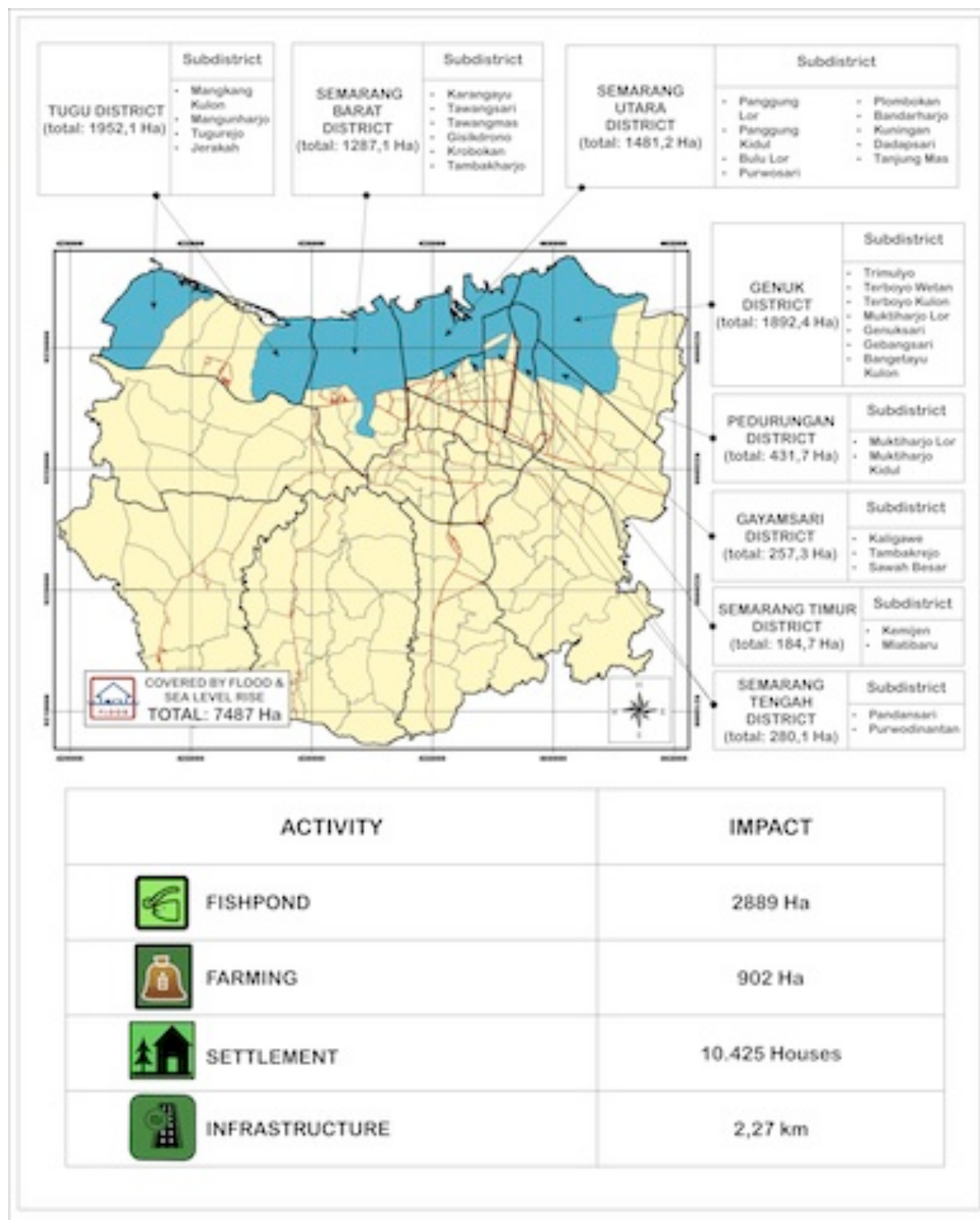


Figure 2.10 shows a decreasing trend in the net migration of the areas of Semarang City that are potential to inundation due to SLR. Unit data at sub-district level from BPS (2003-2008) were used to develop this figure. Zone 1 consists of some sub-district that is currently inundated, while zone 2 and 3 consist of sub-district that will be flooded by SLR in the medium (at 35 cm SLR) and long term (at 65 cm SLR) respectively. Since 2005 (axis 3) the net migration decreased indicating that less people come to the areas. It also possible to say that the areas have not attracting for migration anymore. Even in some sub-districts have negative net-migration.

Source: Setiadi and Kunarso (2010)

Figure 2.11: The Impact of SLR in Semarang City



An economic valuation study on the impact of SLR in general has been carried out by the Marine and Fisheries Ministry or DKP (2008). A more detailed economic valuation study on the impact of SLR and flooding in dense residential areas of Semarang has been done by the BINTARI foundation (2007) and it is then updated by the Sectoral Studies Mercy Corps (2010). Table below summaries the economic loss as a result of sea level rise and flooding in Semarang City.

Table 2.4: Economic Valuation of Coastal Degradation (DKP, 2008)

Type of Activities	Impact	Economic Loss (IDR)
Mangrove Ecosystem	Hectare	729,351,612*
Fishponds	2,889 Hectare	110,937.600
Rice Fields	902 Hectare	29,221,560,000
Settlements	10,425 Houses	208,500,000.000
Infrastructure	2.27 Km	5,602,961,405

Note: * calculated from the total economic value (Per Ha/Year)

Table 2.5: Annual Average Economic Loss Each Respondent due to Flood and SLR in Kemijen Sub-district

Assessment Aspects	Year 2007 (IDR)	Year 2010 (IDR)
Housing	5,000,000	5,004,000
Productivity	1,000,000	10,800,000
Education	0	1,110,000
Health	0	1,440,000
TOTAL	6,000,000	18,354,000

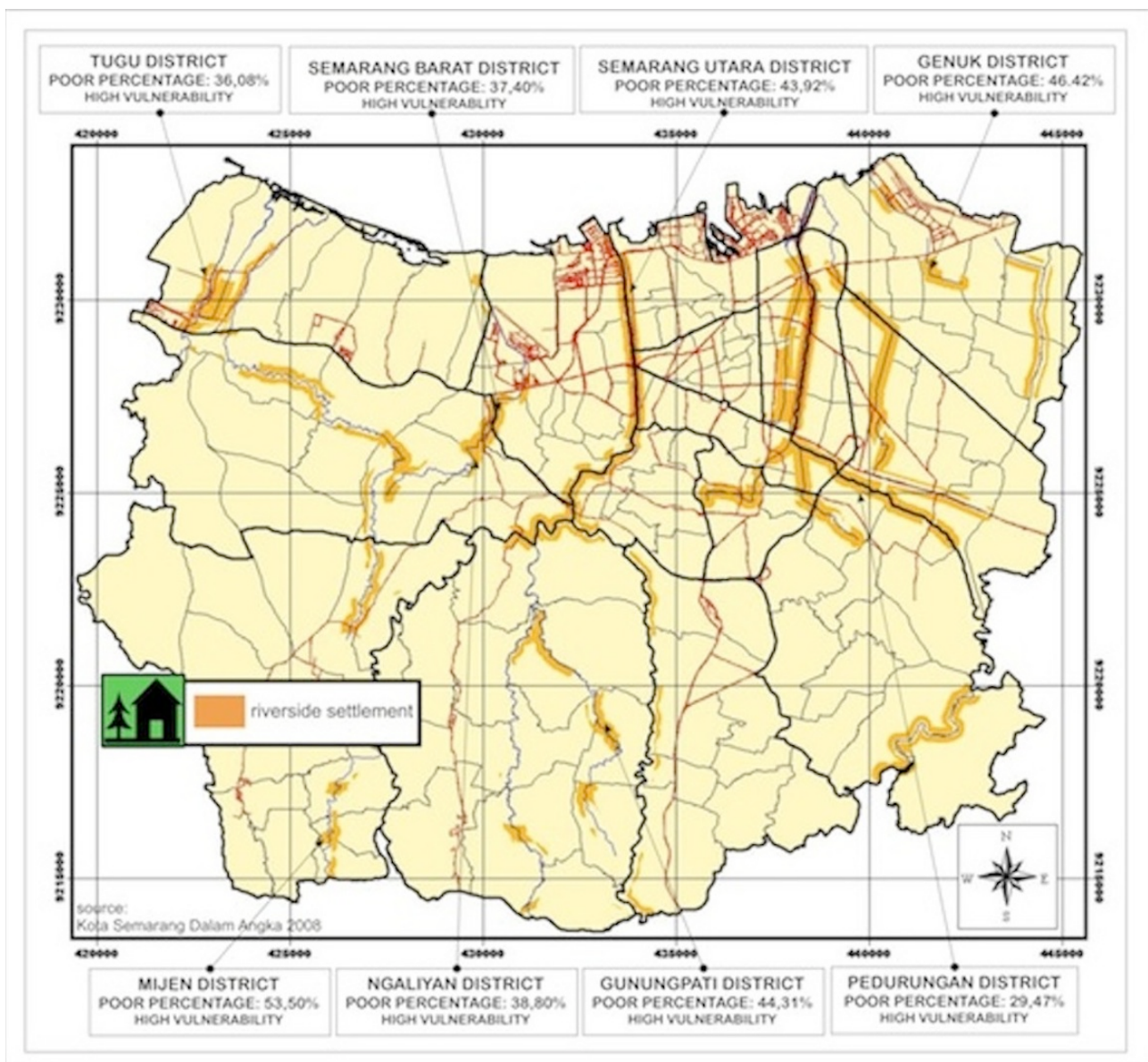
Source: Bintari (2007) and PLRT FT UNDIP (2010)

The economic loss of education and health had not been emphasized by 2007 study but it is in 2010 sector study. In the later study, economic loss of education sector is calculated from the disfunction of school properties and additional transport cost to children who study outside of Kemijen Sub-district. The economic loss of health sector is counted from the people expenses to medical service following the flooding. The loss of productivity is calculated from the direct income loss due to flooding. The differences of economic loss due to the number of days off as a result of flooding increased significantly. On the other hand, the average income of people in Kemijen is relatively stagnant.

2.2.2. Settlement Areas Located in Riverbed which are Exposed to Flooding

Residential areas located in flood plains areas are also classified as areas vulnerable. The following figure is the map of settlements around the banks of the major rivers in Semarang City.

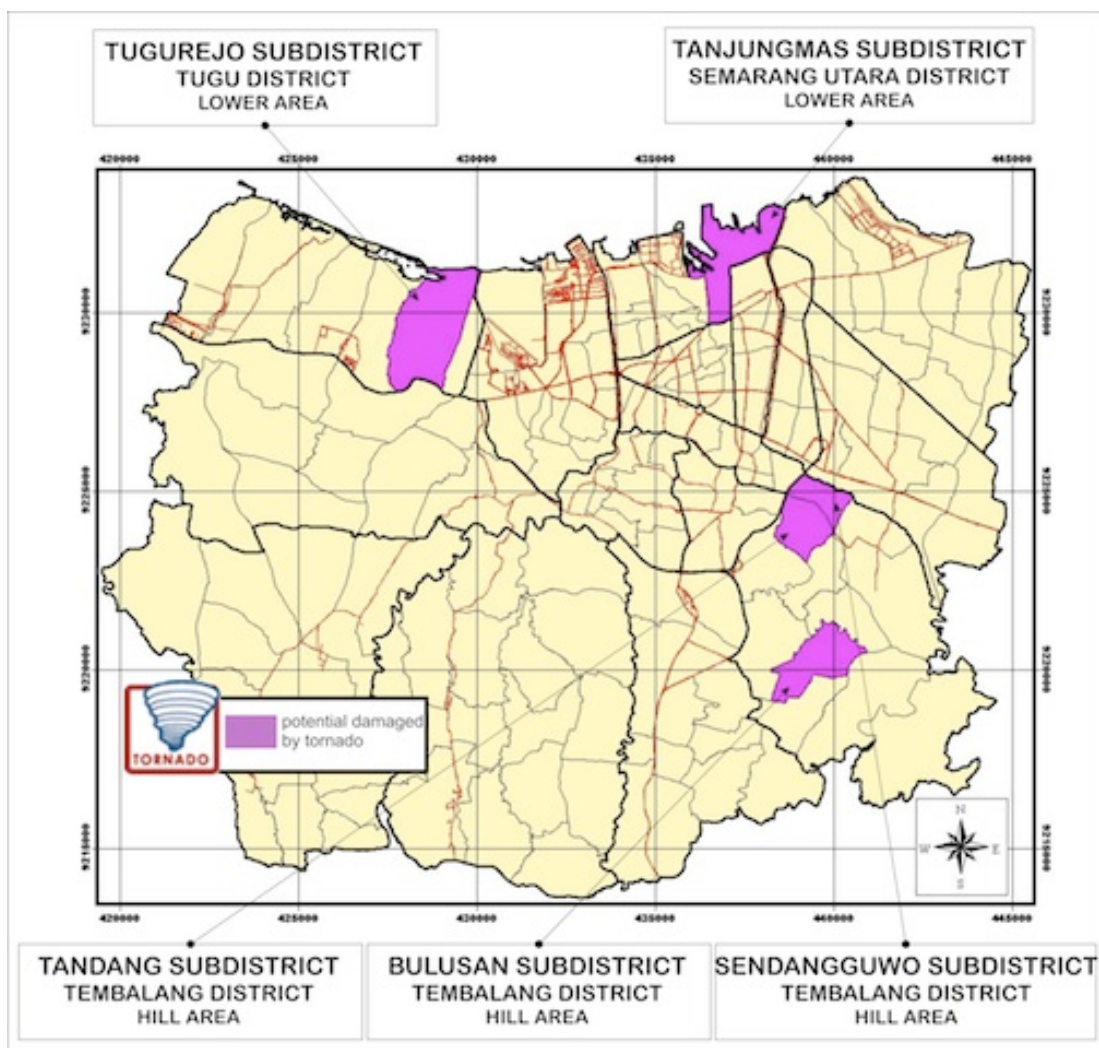
Figure 2.12: Residential Areas in Riverbed of Semarang City



2.2.3. Hilly Areas which are Exposed to High Winds

As a result of extreme weather, high winds also often provide a serious threat to Semarang City. There is no accurate record of the intensity of this event. However, strong winds incident was encountered by some sub-district in the hilly area of Tembalang District, such as Sendangguwo, Bulusan, and Tandang. On the other hand, high winds in the lowland areas have occurred in Tugurejo Sub-district, Tugu District and Tanjung Mas Sub-district in North Semarang District. However, the most intense incident located at Tandang Sub-district.

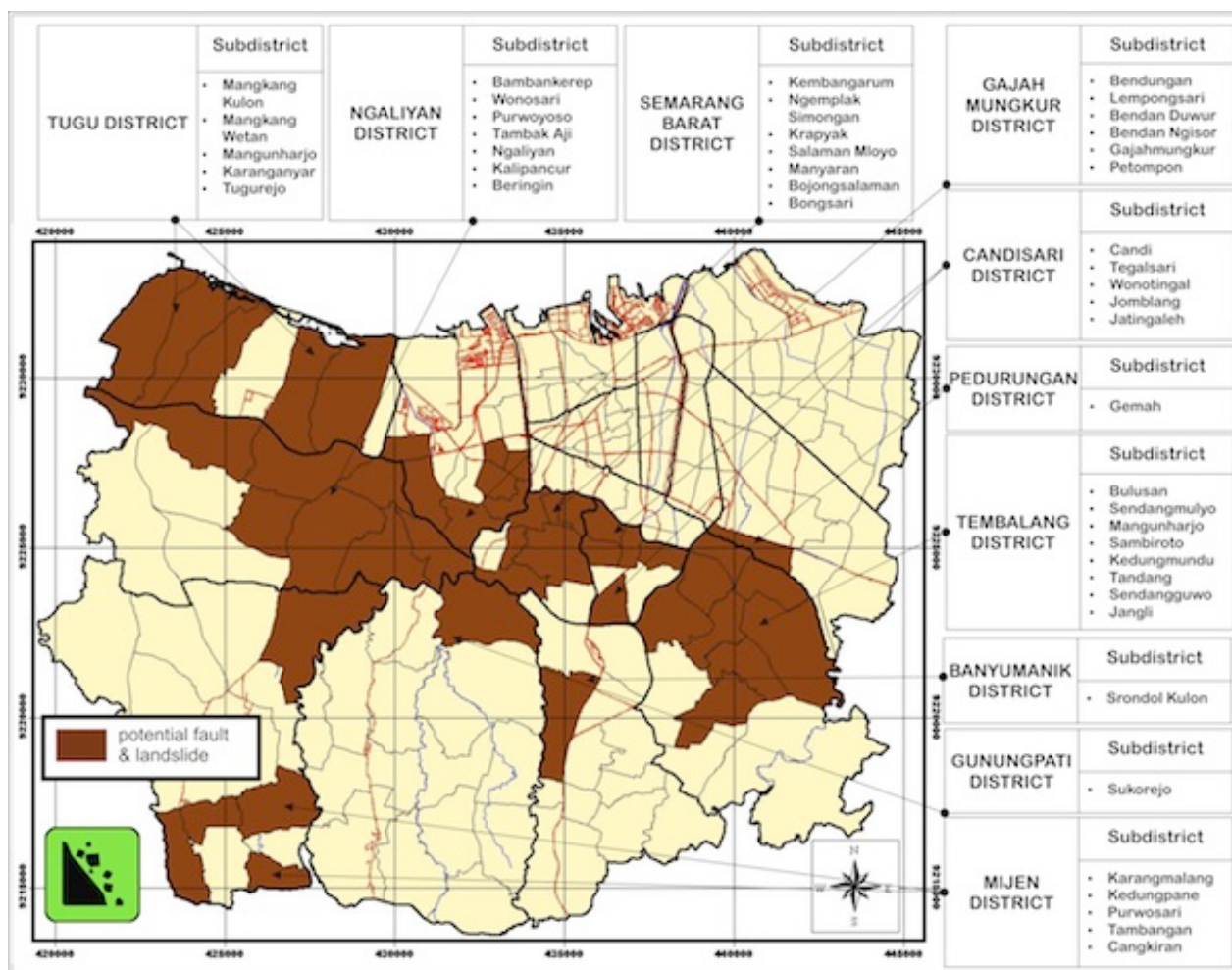
Figure 2.13: Areas Prone to High Winds in Semarang City



2.2.4. Areas which are Exposed to Land Movement, Landslides, and Abrasion

A more intense rainfall in the wet season due to climate change could exacerbate the possibility of land movements and landslide in some hilly areas of Semarang City, while the wave circulation leads to abrasion in western part of coastal areas. The following figure shows areas of Semarang City which are prone to soil movement, landslides, and abrasion based on a study that have been conducted by CCROM IPB (2010).

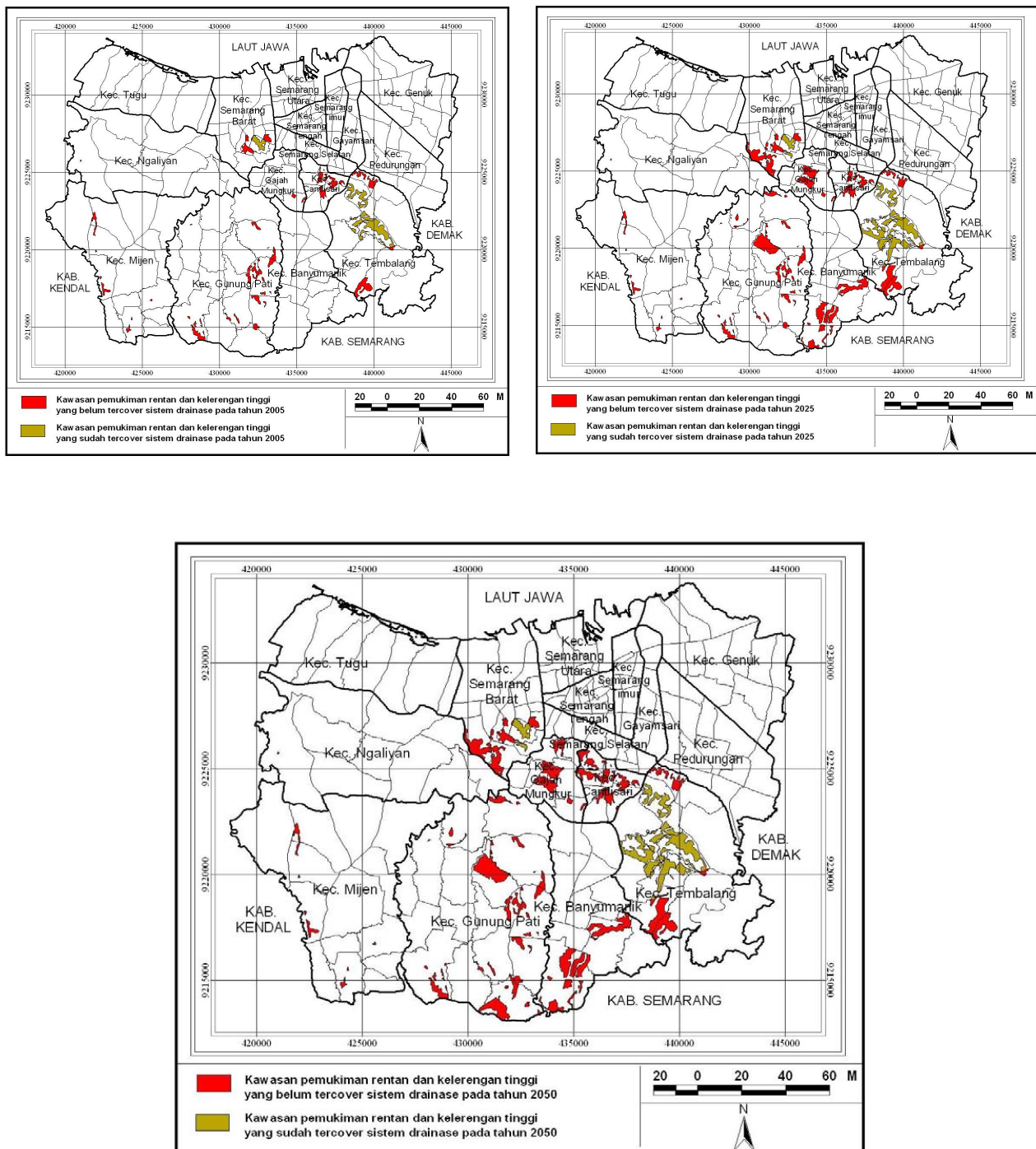
Figure 2.14: Area Prone to Land Movement, Landslide, and Abrasion



The result of sector studies (FT PLTR UNDIP, 2010) recommend a specific site which are crucial to be managed to deal with catastrophic landslide. These locations are priority to handle because: (1) the settlements have a slope above 25%, (2) at the same time they do not have an appropriate drainage

network, and (3) the location itself is in the high vulnerability category based on the VA study. The following map is the specific site in question.

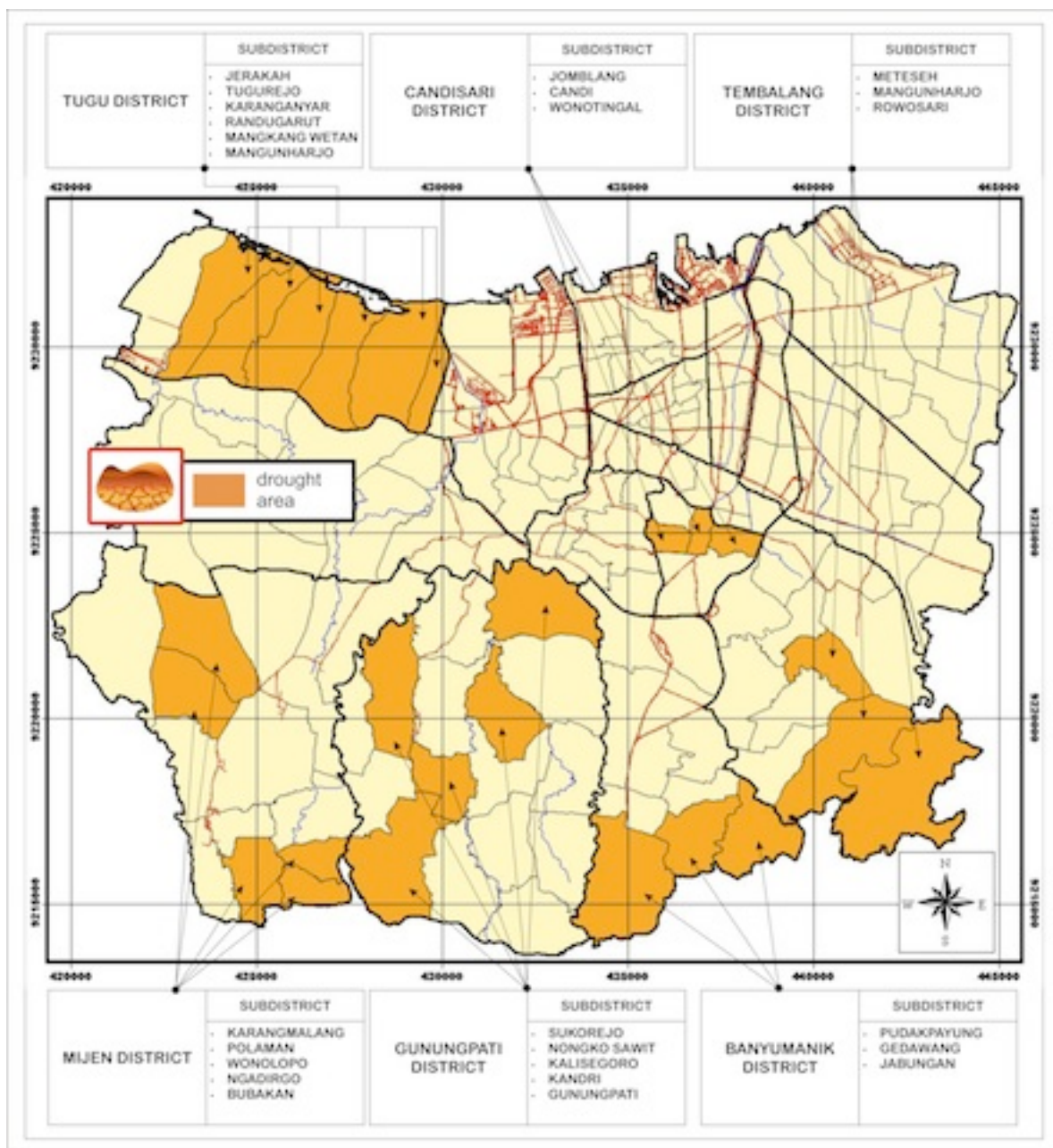
Figure 2.15: Highly Prioritized Areas to be Managed in Dealing with Landslide (PLRT FT UNDIP, 2010)



2.2.5. Settlement Areas in Urban Fringe which Far away from Water Sources

CCROM IPB (2010) identified a number of Semarang City's areas experiencing drought because they are far away from water sources. The identification results can be seen from the following map.

Figure 2.16: Drought-Prone Areas in Semarang City



2.2.6. Areas as a Node of Movement

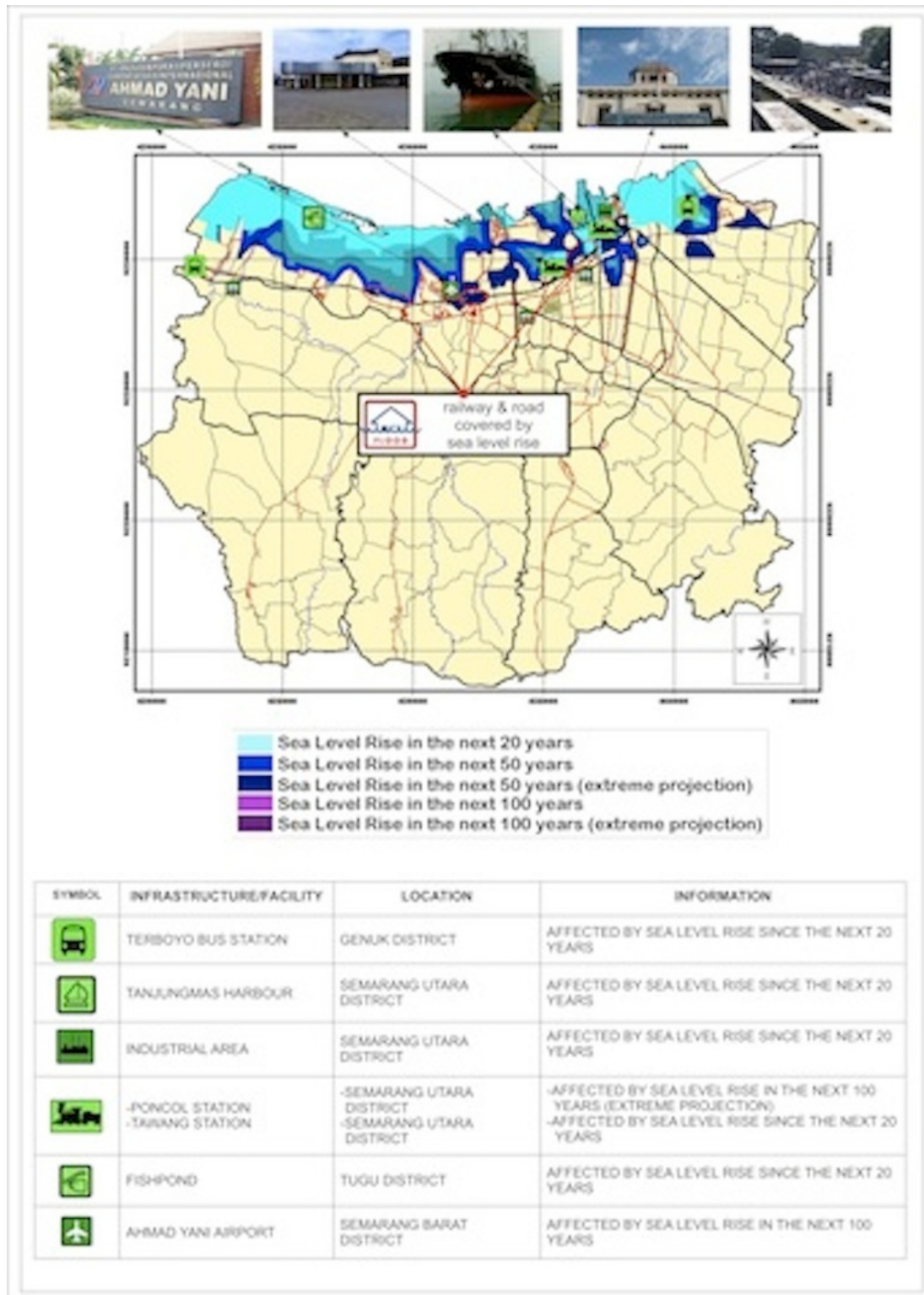
Transportation facilities which are vital to Semarang City such as Ahmad Yani Airport, Tanjung Mas Harbor, Tawang Railway Station, and Terboyo Bus Terminal are located in potential-flooded areas. Ahmad Yani Airport has experienced paralyzed in a day because of heavy rains that triggered flooding on the runway. Tawang Railways Station also experienced the same story. This strategic infrastructure, particularly Tawang Railway Station, Tanjung Emas Harbor, and Terboyo Bus Terminal often suffered from flooding and high tide. These facilities are the pulse of the movement of people, goods, and commodities that are vital to the urban economy. The following figure shows where one of node movements areas in Semarang City threatened due to climate change .

Figure 2.17: A Railway Station which Located on Inundated and Flood Prone Areas



Source: DKP, 2008

Figure 2.18: Nodes of Movement which are Prone to Increasing of SLR



Sea-level rise has influence to the increasing of Wave Set-up and Wave Run-up contained in the vertical sea wall port building (on the eastern part of Semarang's west flood canal). Based on the calculation of sea level rise average at of 8 mm/ year with 20 years simulation, 16 cm sea level rise would increase the Wave Set-up and Wave Run-up at 4.1 cm or 10.59% and at 7.7 cm or 1.51% respectively. In contrast, with the same assumption, there would be a decreasing in security factors (FS) equal to 0.37 cm or 18.45%.

If it is calculated over the next 100 years when there is 80 cm sea level rise, Wave Set-up and Wave Run-up will rise by 10 cm or 51.73% and at 1.6 m or 31.64% respectively, while safety factors will at 1.16 m or 57.67%. This means that the higher its SLR the greater both wave set-up and run-up, but the lower its safety factor (DKP, 2008).

2.2.7. Functional Areas of Central Business District

The condition of seawater inundation in Semarang City has reached an alarming stage. Besides as the impact of sea level rise, such condition is exacerbated by land subsidence. The inundation infiltrate into the mainland through urban drainage networks, which their conditions are unfavorable. The impact caused by seawater inundation is very broad such as: disruption of industrial activities and regional markets. Inundation in Semarang City and its impact to functional areas of central business district can be seen in Figure 2.19..

2.2.8. Industrial Areas

In the northern areas of Semarang city there are a number of industrial areas, particularly in District Genuk and District Tugu. Based on projections of sea level rise, the industrial area will be flooded. These industries consist of various kinds, ranging from household industries, small industries, to large industrial companies. If these industrial areas flooded so it would result in some impacts, including (Setiadi and Kunarso, 2009): (1) existing production activities will inhibited, (2) import-export activities will be disrupted, (3) coastal areas are not attractive anymore as an interesting location for investment , (4) reduced demand for labor in the industrial sector, and (5) regional income declining. The industrial area that will be flooded approximately 108.2 Ha. Threatened industrial areas in Semarang northern part due to rising sea levels also has an impact on livelihoods, especially those

who are working as laborers. In addition, the number of workers as industrial workers in the area will be around 65,737 inhabitants. They are people who are vulnerable to loss their source of income when their livelihood collapsed. In the long-run, this might decrease the city economic performance and reduce the quality of life.

Figure 2.19: Semarang's Functional Areas which Threatened by Climate Change

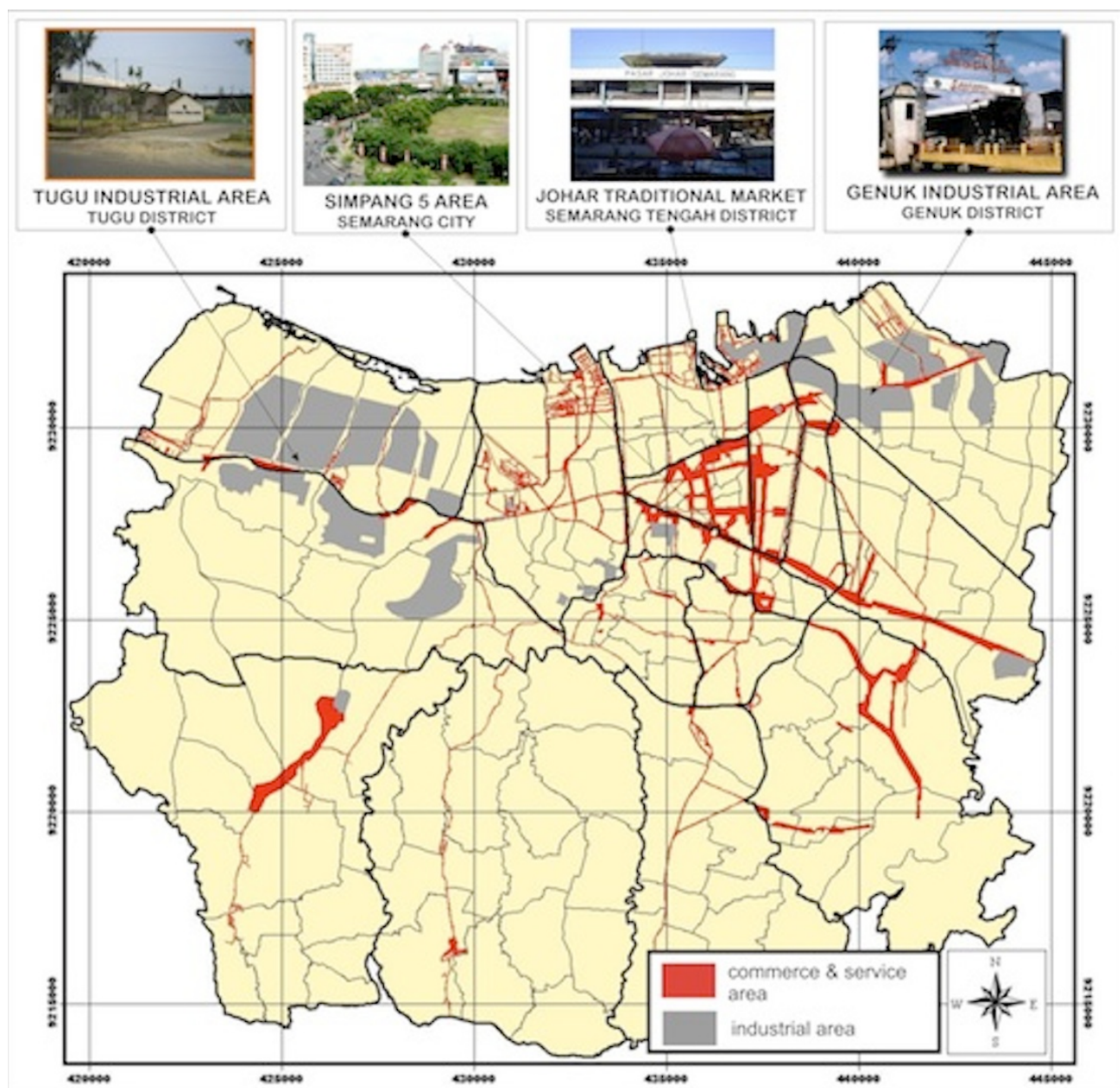
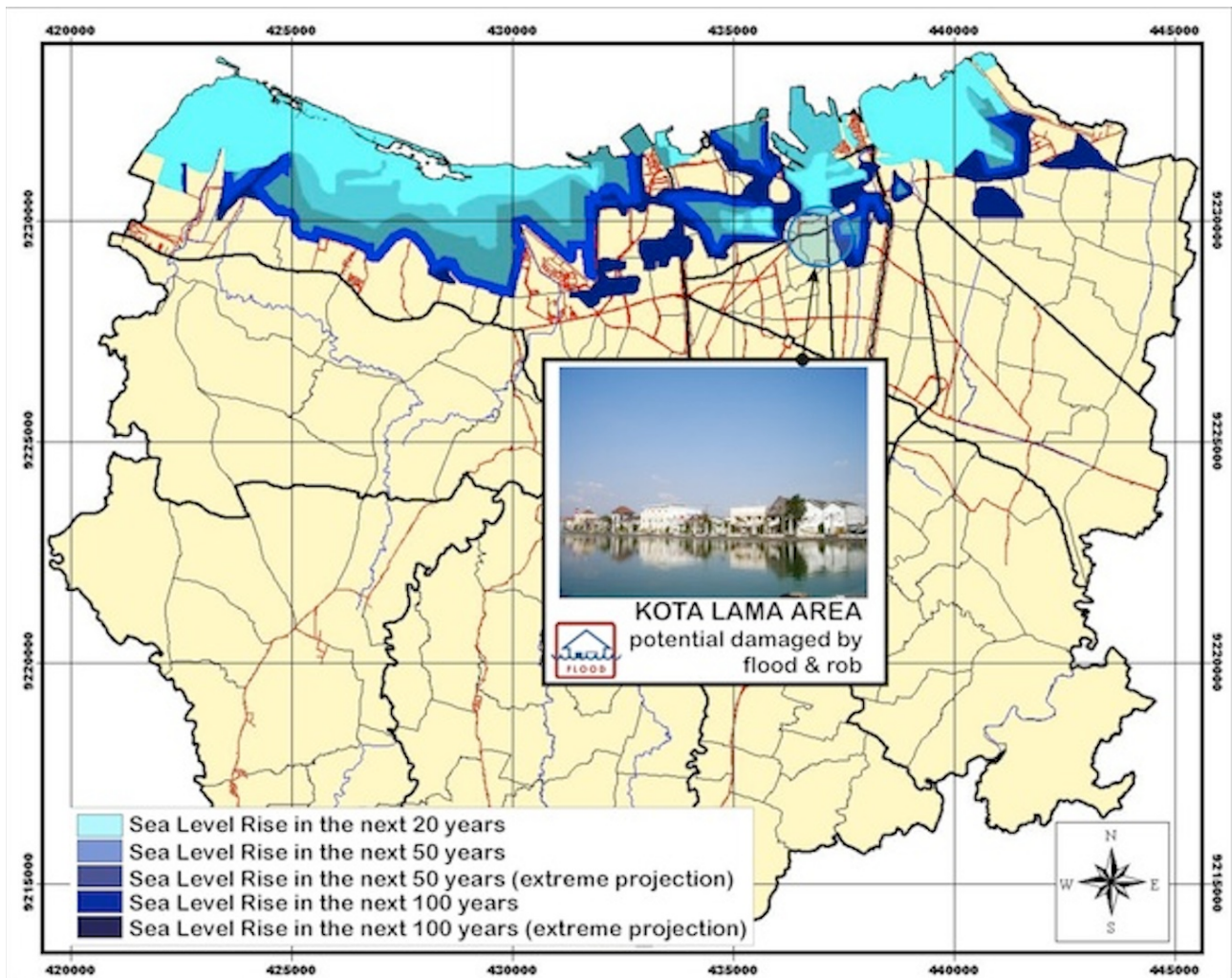


Figure 2.20: Semarang's Old Town which are Threatened as a Result of Climate Change



2.3. Vulnerable Groups

From the above explanation, it is clear that climate change is closely related to disasters such as landslides, high winds, and drought. The rising sea levels and high precipitation followed by flooding is not only result in physical impacts to the city, but also impact on social, economic, cultural, and public health. The impacts may lead to ineffectiveness of government and community investment in the region.

A number of vulnerable groups in Semarang City has been identified and they need to be considered in the preparation of city resilience strategy. These vulnerable groups consist of (Mercy Corps, 2009: 9-11):

- **Urban poor residents.** Urban poor residents are considered vulnerable since they often occupy those areas of the city that are the most exposed to risk. Seeking areas which are inexpensive, easy to occupy and close to employment opportunities the urban poor often are forced to settle in places that are precarious, such as riverbanks, steep hillsides, beside train tracks, on abandoned land or on unsuitable land (rubbish dump sites for example). Since there is often no legal recognition of these settlements, or at the very least they are tolerated by city governments for their temporary status, they occupy an ambiguous situation. They are not fully recognized and yet they are allowed to remain, so few public investments are made and their vulnerability persists.
- **Groups of families moved in government relocation programs.** Government's relocation program in the past was not well prepared. Families who have been moved from one settlement to another by government relocation programs are particularly vulnerable given the sudden changes to their lives and the difficulty in restarting life in new surroundings. A number of people who are currently living in Tandang and Sukorejo Sub-district are the example relocated community as the government implemented major improvement on drainage system (Semarang's western flood canal). Often without access to jobs, little capital and having been uprooted and dislocated from their previous communities, these communities often suffer prolonged hardship in starting up their lives anew. As a result they live in precarious circumstances, with little or no social safety net to support them if they fail to adjust to their new communities.
- **People who live in locations that will be the site of major infrastructure projects.** Given the continually development and demands of major infrastructure projects in Semarang-such as large pumping facilities, dam, toll road, riverbank restoration, newly industrial and housing estate, etc-continually create demand for areas of land for development. Cities continually are redeveloping plots of land. Those who have settled on these lots often do not have legal tenure and little

recognition are vulnerable to being moved without just compensation or the opportunity to negotiate a favorable outcome.

- **Residents who depend on the industry in the lowlands.** Those communities that are dependent on specific industries, such as the port, fishing, and manufactures are vulnerable since they are very reliant on jobs coming from that one sector. This is for two reasons: (i) if there was to be a sudden change in the conditions of that market these communities are situated with few other economic opportunities other than those providing advantages by their proximity to the sea. (ii) Another reason is that they are not inclined to move their houses to safer areas despite them draining their resources, because they depend so heavily upon a constant salary offered by the industries related to the port and manufacture.
- **Urban poor migrants.** New arrivals to the city from the interior or other coastal areas are vulnerable since they have few housing opportunities open to them other than precarious areas which may otherwise not be occupied, or have an illegal status, but which are often in the most vulnerable parts of the city.
- **The elderly.** A particular group that is vulnerable are the elderly since they are often unable or unwilling to adapt to changes in their environment. Given adverse conditions such as flooding or relocation for an infrastructure project the elderly are often resistant to changing their lives so dramatically having gotten used to inhabiting one place, or are unable to adapt quickly to new environments. Elderly who have no families or a support network to assist them are particularly vulnerable.
- **Families headed by women.** Female headed families, either widowed women or single parent households, carry a heavy burden of supporting children and the elderly and so are vulnerable to sudden changes in livelihood, their surroundings and adverse weather conditions. They may have difficulty with maintenance of housing or other manual labor which men are usually responsible for, compromising their security.

3. National and City Policy

3.1. National Policy to Respond Climate Change

Climate change sectoral roadmap document or more known as The Indonesia Climate Change Sectoral Roadmap (ICCSR) has been the main reference on national-wide policy in dealing with climate change. The document advises National RPJM 2010-2014 and National RPJP until 2030. The document emphasizes a number of challenges that arise over climate change in forestry, energy, industry, agriculture, transportation, coastal area, waste, and health. Climate change adaptation strategies are formulated mostly in agriculture, clean water, coastal, healthy than other sectors.

Table 3.1 The Direction of Adaptation Policies According to ICCSR

Sectors	Policy Direction in Adaptation and Mitigation Strategies
Agriculture	On food crops and horticulture through: Improved management of water management, including systems and irrigation networks; Development of water harvesting technologies (ponds, trench dams) and the efficiency of water use such as irrigation drip and mulch; Development of species and varieties of plants tolerant to environmental stresses such as increase in air temperature, drought, inundation (flooding), and salinity; Development of soil management technologies and crops to improve crop adaptation, and Development of farm protection system of failure due to climate change or weather crop insurance. In plantation crops through: Development of commodity which can survive in stress drought and excess water; Application of soil and crop management technologies to increase crop's power adaptation; Development of water-saving technology; Application of water management technologies, especially on land prone to drought. On farm management: Development of livestock more adaptable to extreme environments (such as Drought, high temperature, inundation); Development of silage technology to cope with food shortages, Seasonal Development of integrated crop-livestock systems (CLS) to reduce the risk of and optimizing the use of land resources.

Sectors	Policy Direction in Adaptation and Mitigation Strategies
Health	Strengthening early warning systems and emergency response in the community; Strengthen review on vulnerability and risk assessment of the health sector due to climate change: Developing a policy framework supported by legislation and regulation; Develop planning and evidence-based decision-making areas; Improving cross-sectoral cooperation; Increase community participation, private and higher education; Strengthen the ability of local governments; Development of networking and sharing of information; and improve the quality and quantity of clean water and community sanitation.
Waste	Carry out a more complete and perfect review of GHG inventory of waste sector to accompany a systematic plan for GHG reduction; Applying environmentally sound waste management policies in the field of infrastructure development supported by environmentally sound development and applied technology research; Develop environmental policy implementation to the principle of 3R (reduce, reuse, recycle) in waste management: Developing a sustainable infrastructure development (By balancing three pillars of development, namely economic, social, and environmental) with reducing GHG emissions (GHG) and increasing carbon sequestration; Conducting solid waste infrastructure development sector that put concern the capacity of human resources and institutions including local government competence and independence to promote environmentally sound infrastructure development and to encourage the role of the private sector and communities; Develop waste management technologies that are environmentally friendly and anticipative to climate change; Developing the application of EPR (Extended Producer Responsibility) to hazardous waste producers and importers; Develop quality improvement of landfills technology.
Marines	In the group of inventory data and research activities include: Strengthening the capacity of research on the phenomenon, hazards, and potential impacts of climate change; Strengthen the capacity of adaptation and mitigation assessments more appropriately in accordance with the conditions of vulnerability and local wisdom. In the group of planning activities: Integrate climate change in planning documents and management of maritime affairs and fisheries. In the group of policies, regulations, and capacity building: The preparation of norms, standards and guidelines adaptation and mitigation of climate change; Adjustment of regulations and activities related to climate change; Accelerate regional head decision in the preparation of Strategic Planning Document (RENSTRA) in Maritime Affairs and Fisheries has to consider climate change issues; Improved institutional capacity and monitoring and control. In groups of implementation activities: Adjustment strength of coastal structures, Maintenance and rehabilitation of coastal ecosystems and small islands, Anticipating the sinking of small islands, especially outermost Indonesian island, Developing disaster reduction and climate variability on the coast, Anticipation of fishing ground's shifting area towards the sea and their sustainability of fisheries production capture, in anticipation to particular fish species that are not resistant to temperature changes.

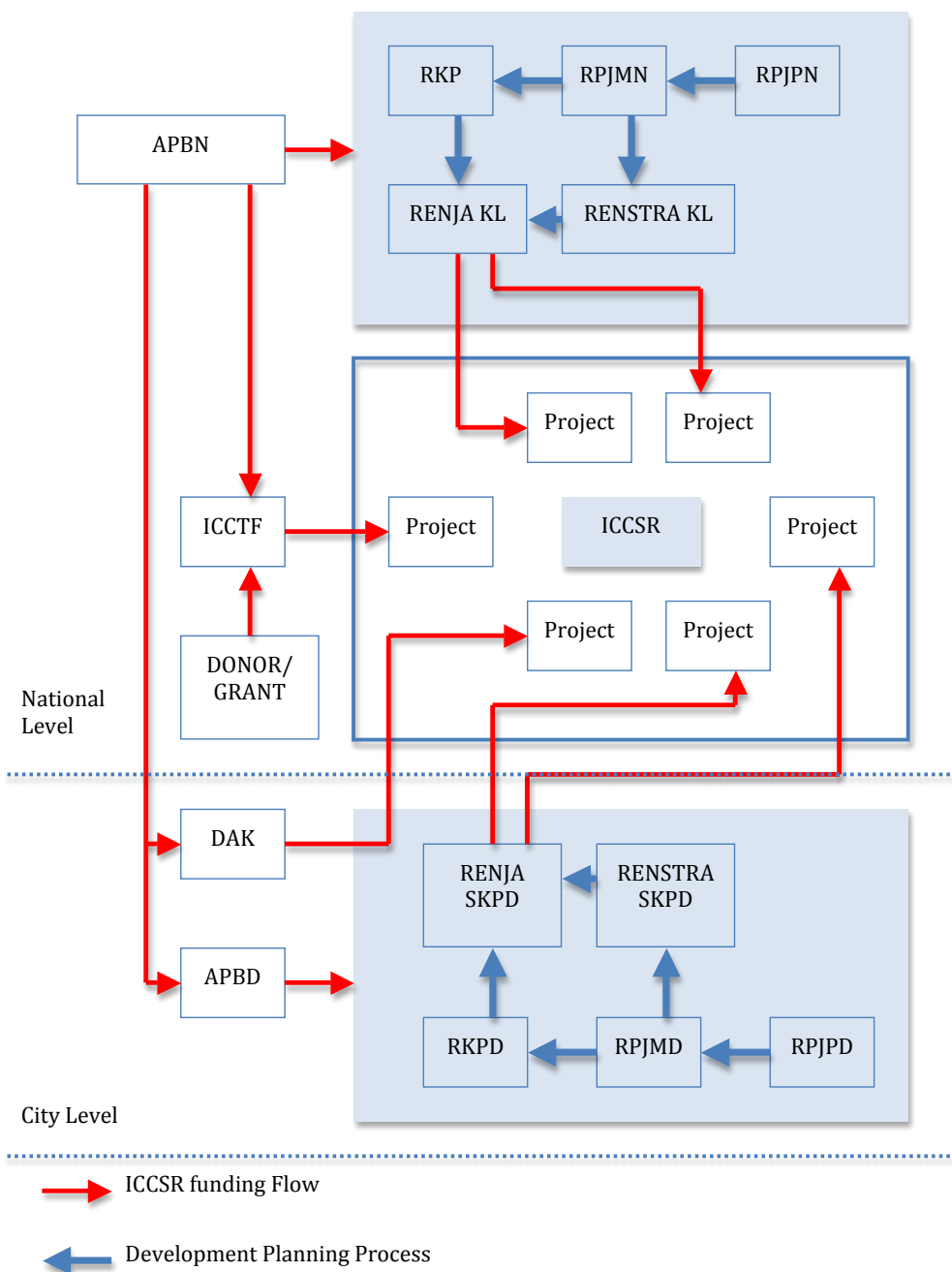
Sectors	Policy Direction in Adaptation and Mitigation Strategies
Water Resources	Carry out hazard assessment, vulnerability, climate change impacts on natural resources sector which is more detailed; Increasing the capacity of data and information in term of natural resources, including its availability, needs, resources, and how residents obtain water through updates, upgrades, and providing public access to data and information resources; Strengthen the capacity of water resources in order to improve the situation of water supply; Increase or apply the concept of conjunctive use of surface water potential of the area is less; Increase provision and public access to data and information concerning water- related disasters and climate change such as floods, droughts, and landslides; setting (regulation) of the Act further resources at the national level and areas that consider climate change issues; Set or secure areas or water catchment or protection of water resources and protected areas of socialization and adaptation to climate change campaigns water sector.
Energy	Fuel pricing with more balanced (fair); Policy natural resource price of renewable energy; Requiring renewable energy resources; Tax or carbon tax from fuel burning activities; Development of the fuel gas supply infrastructure; introduction of new technologies and cleaner technologies using coal, and mixing policy with biofuels
Industry	Improving energy efficiency and energy diversification; Monitoring GHG emissions; Modification and replacement of technology

There are two ways of funding in order to implement policies pointed out in the ICCSR into actions. Firstly, the ICCSR policies will be funded by national government budget (APBN) after the policies are elaborated as programs within national mid-term development planning (RPJMN). Still from the same funding source, additionally the implementation of the ICCSR at city level is through a Special Budget Allocation (DAK) mechanism from national ministries and departments to province government before they forwarded to the city level. Semarang City so far received DAK from two ministries namely environmental ministry (KLH) and marine and fisheries ministry (KKP).

Secondly, the ICCSR policies will be funded through the Indonesian Climate Change Trust Fund (ICCTF) which are coordinated by Ministry of National Development/ National Development Board (BAPPENAS). The ICCTF taps the funding and grants coming from donor agencies and APBN. It is expected that the ICCTF can be accessed by any organizations, including local governments at city level or local NGOs at the grassroots who are concern with climate change adaptation and mitigation. Therefore, availability an organization at city level which specifically able to support local government to transform ICCSR policies into action is imperative. While the former is basically a

formal mechanism, the later is more quick and flexible. Unfortunately, there are many critics on the clarity of procedure to access the ICCTF.

Figure 3.1: ICCSR Implementation at National and City Level



3.2. Semarang City Development Policies

As stipulated in law and national development planning system 25/2004, Semarang development policies outlined in the document long-term development plan (RPJPD) and regional medium-term development plan (RPJMD). Each of the documents described in the following sub-chapters.

3.2.1. Direction and Long-term Development Priorities

By reviewing documents RPJP Semarang City Year 2005-2025, the direction of Semarang city development in recent decades to come might be outlined. Long-Term Development Plan of Semarang City contains several strategic issues and expected conditions to Semarang city within the next 25 years. The following table presents a concise direction and priorities of long-term development plan.

Table 3.2: Review of Long-Term Development Plan (RPJP) Semarang City

PROGRAMS	GOALS	EXPECTED OUTCOMES
ECONOMY		
Trade and Services	Increasing the contribution of resources trade to reach at 35.45% in 2014	Increasing economic growth followed by community per capita income Anticipating the impact of trade globalization, which has impacts on the strict competition.
SMEs and Micro Finance	Strengthen middle down economic community Finding the economic potential and improve competitiveness of SMEs	Pressing the level of poverty in the community who experience increase of 0.21% during 1993 - 2004 Promoting economically independent community Penetrate export markets and increase national incomes
Investment	Creating a conducive climate investment, ie mainly the protection of investors and simplification of bureaucracy for investment	Attract investors, both domestic and external country because of security and convenience for investing Increasing economic growth
Industry	Socializing environmentally friendly industry/ Green industry Building partnerships, capital-intensive industry with a small industry to have mutual benefit	Social sensitivity to global warming and increased environmental health Support the existence of small scale industries with the partnership with large industry. Contribute to economic growth which showed positive trends 3.35% to 3.95% from 2000 to 2004

PROGRAMS	GOALS	EXPECTED OUTCOMES
Employment	Creating new jobs for growing labor force. Reducing the social gap	Pressing the crime rate caused by high unemployment problems Pressing the projected high rates of unemployment that will reach at 62.84% in 2025
Transportation	Improving and optimizing the conditions of damaged roads throughout the 638,754 km of the total road length reaches 2,762,731 km.	Achieve an effective and efficient transportation system in accordance with the hierarchy and the function of roads as well as the realization of transportation system on land, sea and air in an integrated way. Realization of rapid and mass transportation (mass and rapid transportation).
GOVERNANCE		
Public Services	Increasing public satisfaction on government service by establishing a unit integrated service (UPT), standard applications of minimum service, complaints and hotline service to improve performance, develop the quality of the bureaucracy, develop infrastructure, and create space for public participation.	Increased public confidence to the government that can generate public support for government programs
Law	Improving the performance of law enforcement and quality of regional law.	Increasing law enforcement stability that can support programs government programs.
INFRASTRUCTURE AND ENVIRONMENT		
Spatial Planning	The creation of structure and spatial pattern effectively and efficiently in accordance with hierarchy and its development function	The harmony, sustainability and optimum utilization of space in accordance with the potential and carrying capacity of the region
Water Resources		Support the sustainability of water resources for urban activities
Drainage	The creation of coherence in management of drainage from upstream to downstream	Sustainable urban drainage system
Waste	The integration of waste management systems at urban scale	The sustainable urban waste management system
Pollution	Pollution management and environmental friendly development of green open space system	Improving the quality of urban environment
Housing and Settlements	Meeting the needs of housing quantity and quality as population grows	Management of a healthy housing environment based on community

PROGRAMS	GOALS	EXPECTED OUTCOMES
Public Facilities	Meeting the needs of urban communities and facilities	The provision of urban public facilitiescommunities and urban facilities that can support Semarang City as a city of trade and metropolitan scale services
HUMAN RESOURCES		
Health	Improving community health status through: Promotive, preventive and curative activities Creation of healthy environment Support medical professionalism Adequate health facilities and infrastructure Development of the community health care system	Increasing the degree of community quality of life that can be seen in the following indicators: Life Expectancy in 2025 will reach 75 years, reaching 4.00 Infant Mortality / 1000 birth, maternal mortality rate reached 42/100.000 give birth Health care coverage to 100% of the total population
Tourism and Culture	Development of tourism as a fulfillment of community needs and assets to create city's magnet. The development of local culture as tourism potential Development of tourism as a fulfillment	Increased contribution of tourism in the city economy Preservation of local culture as an aspect of community characteristics forming
Education	Improving community awareness for the importance of education for the effort to improve quality of life	9 years mandatory up to secondary level for the basic education level of Semarang community Increased community participation to education Achieving gross enrollment rate in each education stage

By understanding the development of Semarang to come, it is hoped the strategy and climate change adaptation action will be formulated remain synergistic and contributive within the comprehensive urban development framework.

3.2.2. Direction and Medium Term Development Priorities

RPJP as a long-term development of plan has been translated into medium-term development plan (RPJM). In this medium-term plan, issues and directions of development in every organization, which cover different types of authorities is outlined.

The development of medium-term Plan 2010-2015 in Semarang was in progress, at the same time with the preparation of the CRS. Therefore issues related to and strategies to deal with climate change adopted from CRS was introduced in the preparation and the formulation of Semarang City's strategic issues and mission of Semarang City's medium-term Development Plan. It is stated in the medium-term development plan that: "environmental degradation and quality in Semarang are exacerbated by the climate change and it is urgent for the local government institution to take action in dealing with the climate change".

3.3. Current Issues and Dynamics of Semarang's Urban Development Activities

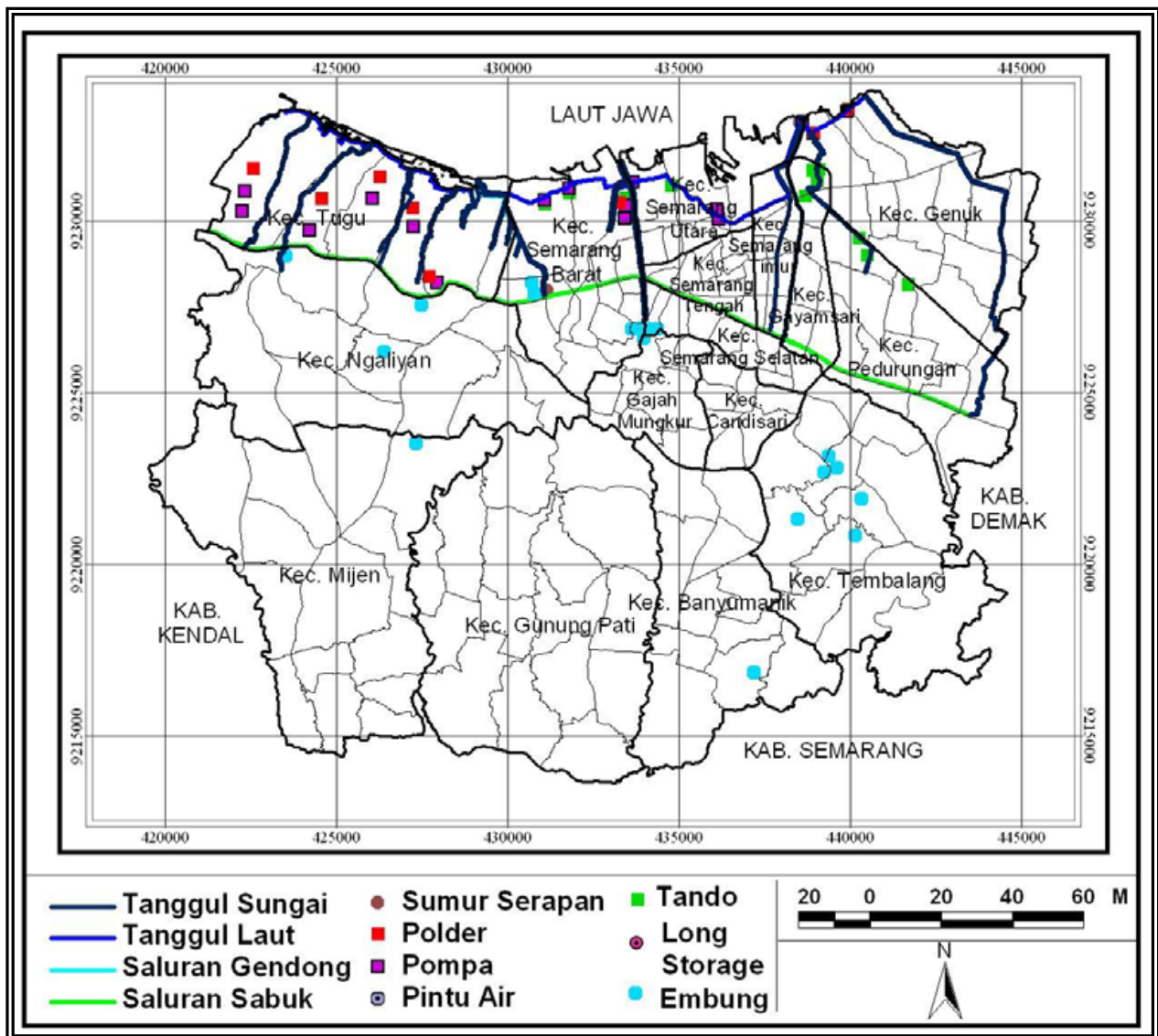
There are several development projects based in Semarang City, which is allegedly significant to affect climate change adaptation activities. These projects are:

1. Kali Banger Polder Development Project, as a part of cooperation with the Dutch and funding from JBIC (Japan Bank for International Cooperation). Polders Development expected to reduce the pressure of floods in the Northern and Eastern Region of Semarang.
2. Jatibarang Reservoir and Dam Development, as a part of cooperation with JBIC (Japan Bank for International Cooperation). The construction is expected to increase the supply of water in responding to the increasing demand of clean water and to the possibility of shortfall especially in the dry season.
3. Sea Embankment Construction. Sea dike will be stretched across the northern part of town. The discourse on the construction of sea dikes is initiated by Semarang City Government. The dike is proposed to deal with flooding and seawater inundation which had a long story that has not handled thoroughly.

These three projects are to be regarded as the mega-project in Semarang City which should be noted their existence in the analysis of development scenarios. The analysis of development scenario will be presented in next chapter. The following figure is some components of Masterplan

Drainage which its implementation will have a positive contribution to deal with flooding and seawater inundation.

Figure 3.2: Infrastructure Components Development Plan Drainage in Semarang City



Source: Semarang's Masterplan Drainage in PLRT FT UNDIP (2010)

4. Scenario Development

4.1. Assumptions

The following points are the data and assumptions used to perform development climate scenarios in Semarang City.

1. Area city of Semarang is 37,330 hectares (BPS), while the coastal area of Semarang is 4,575 hectares (DKP).
2. The rate of population growth for the projection is 1.2% (using the same rate used in Semarang's City Masterplan - RTRW) by using the model exponential estimates.
3. The intensity of the floods of 1989-2007 is 21 months, equivalent to 1.2 months per year or equivalent with 36 days. Margin rainfall brought flooding are 302 mm/month (CC-ROM IPB, 2010). While the increase in the maximum rainfall was 50 mm/month. Number of months wet and dry months based on CRU TS2.0 dataset analyzed by CCROM-IPB (2010)..
4. The basis data for the assumption of SLR in 50 years from now is SRESA B1/A2: 21 cm (CCROM IPB, 2010) and the more extreme projections is 38 cm (DKP, 2008).
5. The number of people served by PDAM today is 11,000 households, or it is equivalent to 550 000 inhabitants.
6. With the Jatibarang reservoir upstream conservation, discharge produced by the reservoir is 0:26 m3. Standard clean water needs are 120 liters/people/day or it is equivalent to 600 liters/household/day (BPS), thus producing an additional reservoir of clean water for 37,500 homes ladder. Without conservation in the upstream, the contribution expected from the reservoir will decline by half or only provide for 18,500 additional households.

7. Semarang long coastline is 25 km from the east to the west. The ideal thickness of mangroves for coastal protection is 100 meters, so the ideal total area of mangroves to coastal city of Semarang is about 250 hectares.
8. The total area of current fishponds is according to data in 2009 covering 1002.1 hectares area. The rate of decreasing fishpond is about 42 hectares within 5 years (DKP, 2010) and the economic loss per hectare of ponds is equal to Rp.18 Million.

4.2. Climate Change Scenario Development in Semarang City

4.2.1. Dry Season Scenario

Based on the trend data in Semarang City, the average of the dry season is 3 (three) months at MAM. Along with climate change, drought is expected to become longer presumably at 4 (four) months. If the current Semarang City's population is for about 1.4 million inhabitants, then in the next 50 years Semarang's future population will be 2.9 million inhabitants. The dry season, which is getting longer, will have effect on the availability of the PDAM taps water. If the current 60% population of the city not served by PDAM and there is no additional raw water and the long dry season remained about four months, then 80% of the population in 50 years from now will not get service PDAM taps. If within a near one-month dry season becomes longer, the number of people who are not served taps will increase up to 70% and in 50 years that will come, it is predicted approximately 85% of the population does not get service PDAM taps.

4.2.2. Dry Season Scenario After Dam Development and Without Upstream Conservation

Jatibarang Reservoir Development which will be completed in 2015 will give positive implications although still leaves a problem. With the reservoir development but without appropriate conservation in 2015 and long 3-month dry season there will be 54% of people without clean water taps and underserved that number increased to 63% when the dry season occurred 1 month longer. With the same scenario, by 2050 the number of people without clean water taps increase at 78% and 82%.

4.2.3. Dry Season Scenario After Dam Development With Upstream Conservation

Conservation Jatibarang upstream reservoir will provide a better effect for water availability. Reservoir development supported by conservation activities, in 2015 and it is assumed that there will be 3-months long dry season, the number of people without clean water taps served is about 47% of people and that number increased to 58% when the dry season occurred 1 month longer. With the same scenario, by 2050 the number of people without clean water taps service increase at 75% and 80%.

Table 4.1: Scenario Dry Season in Semarang City

	Population:1.4 Millions (Current)		Population: 2.9 Millions (Next 50 years)	
	People Uncovered by PDAM Water Tap			
3 Months Dry Season	60%		80%	
4 Months Dry Season	70%		85%	
Post Development of Dam	wo/ Upstream Conservation	w/ Upstream Conservation	wo/ Upstream Conservation	w/ Upstream Conservation
3 Months Dry Season	54%	47%	78%	75%
4 Months Dry Season	63%	58%	82%	80%

4.2.4. Rainy Season Scenario

Based on trend data in Semarang City, the average of rainy season will take place in 2-3 months. Along with climate change, the rainy season is expected to become longer than 4-6 months. If the current urban drainage masterplan realization is only 9%, then in a normal situation 10.8% of Semarang City area will be inundated by floods with a total of 36 days per year. In 50 year a half of the drainage master plan will be realized, the inundated areas will decrease at 6.5% with only 22-day flooding per year. Longer rain season will give effect on the extent of inundation areas. If achievements drainage master plan has not changed and still the same as present condition, inundated areas will increase at 13%. Total flooding-days per year will also increase to 72 days. With

the realization of half of the masterplan urban drainage in the next 50 years, a longer rainy season still causes inundation to about 7.8% of city area and the possibility to have a 44 flooding-days per year.

With less optimal drainage system at this time, it is estimated about 30% of public and private wells are used by approximately 51,000 households are contaminated. If the rainy season getting intense, the number of wells contaminated will increase, where the number of affected communities will increase to approximately 58,500 households. Repairing drainage system in 50 years from now is estimated a reduction to the number of wells contaminated to 20%. However, the number of households utilize these resources will be higher at about 92,800 households. Then if in 50 years from now, a rainy season has become longer the number of people affected will increase to approximately 98,600 households.

Table 4.3 Scenario Rainy Season in Semarang City

	9% Drainage Masterplan are Implemented (Current)	50% Drainase Masterplan will be implemented (Next 50 years)
	Percentage of Inundated Areas	
2-3 Months Rainy Season	10.8%	6.5%
4-6 Months Rainy Season	13%	7.8%
	Number of Days with Flooding	
2-3 Months Rainy Season	36	22
4-6 Months Rainy Season	72	44
	Flooded Houses and Contaminated Wells	
2-3 Months Rainy Season	51.000	92.800
4-6 Months Rainy Season	58.500	98.600
	Areas Prone to Landslide	
2-3 Months Rainy Season	23 Sub-district	8 Sub-district
4-6 Months Rainy Season	38 Sub-district	19 Sub-district

Landslide prone areas in Semarang City are also predicted to increase along with the rate of extreme precipitation. Based on the previous VA study, there are 23 Sub-districts are categorized as a vulnerable area and have a high slope. The number will increased to 38 Sub-district in 2050 if the rainy season lasts 4-6 months. In the future, improvement of the drainage system is assumed to be able to reduce 65% risk at the normal rainy season 2-3 months and it will reduce 50% risk at the more extreme rainfall season (4-6 months).

4.2.5. Scenario of Flooded Areas due to SLR

At present the achievement of Semarang city drainage master plan (MercyCorps, 2010) is only about 9% and it is predicted in the next 50 years the ability to carried out masterplan drainage is up to 50%. In the next 50 years to come SLR will increase by 21 cm (CC-ROM IPB, 2010). A more extreme prediction states that SLR will increased by 38 cm (DKP, 2008). If no efforts to accelerate the implementation of the masterplan drainage, SLR at a moderate level will result in seawater inundation for about 53% of the total area of coastal in Semarang City. The improvement of drainage system in 50 years from now, there will be 13% of total coastal area will be flooded. With a more more extreme SLR, drainage system at this time will make 68% of the total coastal area of Semarang will be flooded. In the next 50 years if half of the target drainage masterplan can be realized the inundated areas will decrease approximately at 28% of the total area in coastal.

Table 4.3: Inundated Areas in Coastal and SLR Scenario in Semarang City

	9% Drainage Masterplan are Implemented (Current)	50% Drainase Masterplan will be implemented (Next 50 years)
	Percentage of Inundation in Coastal Areas	
SLR 21 Cm	10.8%	6.5%
SLR 38 Cm	13%	7.8%

4.2.6. SLR Scenario with Variation Area of Mangrove Conservation

At this time Semarang City has only 37% of ideal on the total area of mangrove conservation. With such percentage, 21 cm increase in SLR (CC-ROM IPB, 2010) will cause 40% of fishpond at this time

will disappear, with total loss of about 7.2 Billion per year. A more extreme prediction where the SLR will increase by 38 cm (DKP, 2008), 75% of current area of fishpond will disappear with total losses reached 13.2 billion per year. On the other hand, the total area of mangrove in Semarang City shows a declining trend. If this declining rate is taken into account and it is assumed there is no intervention, In the coming 50 years, it is estimated that Semarang City will only has 18% of ideal on the total area of mangrove conservation. In other words, mangrove conservation area will decrease by half from now. In this situation, an increase of 21 cm SLR will cause 50% of the current fishponds will disappear with total losses of around 9 billion per year. With a more extreme prediction in which SLR will increase by 38 cm, 90% of the existing fishpond will disappear with total economic loss at 16.3 billion per year.

Table 4.4: SLR Scenario with Variation Area of Mangrove Conservation

	Mangrove 37% of Ideal (Current)	Mangrove 18% of Ideal (Next 50 Years)
	Percentage of Loss on Fishponds from Existing (2009 data)	
SLR 21 Cm	40%	50%
SLR 38 Cm	75%	90%
	Production Loss (in Billions IDR)	
SLR 21 Cm	7.2	9
SLR 38 Cm	13.2	16.3

5. Strategy and Priority for Actions

5.1. Goals and Strategies for Climate Change Resilience

Based on the understanding on urban vulnerability assessment to climate change and climate change scenarios as described in the previous section, there are five sectors that need to be focused in the formulation of resilience strategy in Semarang City. These five sectors are clean water, infrastructure, marine and fisheries, environment, and human resources development. The purpose of resilience strategy in each sector as follows:

5.1.1. Water Sector Resilience Strategies

Resilience strategy on water is intended as an effort to ensure the availability of drinking water for community in Semarang City under extreme climate conditions, both when flooding and prolonged drought. Target of this strategy is prioritized for the community groups which are not covered by PDAM tap service and those living far away from water sources. Several alternative actions to create the city resilience of this water source are:

- **Rainwater harvesting.** Rainwater harvesting is targeted to support the deficit of water supply with application a particular technology which fits to local condition – whether as hilly upstream regions, dense city center, or coastal. There are some technical options to rain harvesting such as through construction of ponds, water tanks on the roof building, dam, artificial well and biophore.
- **Water saving.** The goal of this intervention is reduction the utilization of clean water both individually and collectively. Developing awareness, technology applications, and promoting incentive and disincentive regulation are some actions to translate this strategy.
- **Purification of public wells/ contaminated water source.** The goal of purification is a guarantee that both private and public well owned by community is still feasible to consume. The purification can be done with conventional methods or advanced technology depends on the contamination level.

- **Seawater desalination.** Desalination will significantly improve resilience on clean water, especially in emergency situation. Provision of mobile water treatment is one of possible intervention.

5.1.2. Infrastructure Sector Resilience Strategies

Infrastructure resilience strategy is intended as an effort to reduce the negative impact from flooding when the intensity of rainfall extremely increase. Target of this strategy is prioritized on communities living around the flood plains and the survivability economic centers and the nodes movement to perform their functions. Several alternative actions to foster resilience from infrastructure point of view are:

- **Construction of sea wall.** Basically sea wall is one of required infrastructure to protect infiltration of seawater into coastal land. The sea wall can be developed on the land and on the shallow water areas. Besides to perform its basic function, the sea wall will increase accessibility if the top part of the dike is designed as transportation road.
- **Construction of the channel belt.** The channel belt is a citywide infrastructure to split or distribute rainwater flowing in major rivers from the south to the north of Semarang City. The channel belt lying from the west to the east of Semarang City will slowing down the water velocity and reduce risk of flooding in center business districts.
- **Neighborhood drainage network development.** Neighborhood drainage is one of infrastructure component to improve resilience especially on settlements which are prone to landslide with 15% and more gradient. Inappropriate neighborhood drainage often causes landslide and erosion. The urgency of neighborhood drainage as a tertiary system is less considered in city drainage masterplan and got less priority of funding. In fact, this tertiary system will have influence on the bigger drainage system.
- **Construction of flood shelter.** This intervention is important to increase resilience when extreme rainfall or the failure of drainage system occurs. The construction of flooding shelter is allocated to settlement centers with time and distance consideration. The shelter can be a new building or it just integrated its function with others available building.

5.1.3. Environment Sector Resilience Strategies

Environmental sector resilience strategy is intended as an effort to support sustainability various development programs of the water sector as well as existing infrastructure. With this strategy it is expected that the benefit of clean water programs and infrastructure project can last for a long time and immediately be perceived by the target. Several alternative actions to create resilience from environmental point of view are:

- **Upstream Conservation of Jatibarang Dam.** Upstream conservation is basically a set of activity covering planting activity with suitable vegetation and advocating regulation to limit and control development in Dam Jatibarang's upstream.
- **The management of household liquid waste to protect sources of clean water.** This intervention covers construction of wastewater treatment which locally specific. Micro-finance scheme to increase poor people access to sanitation will be a part of this intervention.
- **Vegetative treatment for settlement areas which are prone to landslides.** There are several vegetation species that can be chosen such as vetiver grass and bamboo.

5.1.4. Marine and Fisheries Sector Resilience Strategies

Resilience strategy of marine and fisheries sector has a strong relationship with environmental sector. Resilience strategy is intended as an effort to protect aquaculture activities in Semarang City from the threat of SLR and abrasion. Target of this strategy is prioritized to communities in coastal area in general and fish farmers in specific. Several alternative actions to create the resistance of this sector are:

- **Development of green belt along the beach surround aquaculture zone.** A variety of techniques of coastal vegetation planting are available, from the conventional to innovative one. The utilization of used tire to wave breaker, instead of as planting medium is one of technique currently initiated in Semarang City.
- **Diversifying marine and fisheries business and product.** The goal of diversification is to economically strengthen people who are working in marine and fisheries sector. So they will be more stable and are able to afford individual adaptation action if necessary.

5.1.5. Human Resource Capacity and Institutional Strategies

Human resource development through formal and informal education and training public and government officials become an important strategy in climate change adaptation. Knowledge and skills obtained will facilitate implementation and encourage the success of the program and climate change adaptation action. Several interventions that can be proposed are:

- **Mainstreaming climate change into education curricula.** The goal of this action is public will have a more understanding on the climate issues, impacts, and challenges. The content of education material and methods depend on different education level, begin with elementary school to university.
- **The establishment of Center for Cities and Climate Change (C4).** This institutional development is to increase government capacity by providing information and data base to support decision making process. This organization also provides training for government staffs especially to equip them with skills to translate strategic strategies into implementable actions. This organization is possible to train other party on request. Although this institution located under government organization structure (called Pusat Informasi Pembangunan), partnership with human resource from universities and NGOs is possible. Semarang City's Technical Team on Climate Change which exist currently can be an embrio of this institution.
- **Involving Private Sector in Climate Change adaptation.** The goal of this intervention is better allocation of CSR of private organizations to climate adaptation activities. This activities can be done by developing a communication forum between government and private or business sectors with a specific topic on CSR and climate change.
- **Evaluating City Masterplan with Climate Change Criteria.** The Semarang City Masterplan 2010-2030 might not workable given the extreme changes in rainfall and sea level rise occurs in the city. New development in the coastal and what are maintained the masterplan such as airport, railway station, industrial areas, and centers of trade and services might fail to perform their function under such condition. Therefore a comprehensive evaluation of the city masterplan are needed.

5.2. Criteria for Resilience Strategy

In the proposed adaptation activities to urban resilience, resilience criteria should be taken into account. These criteria include (the Rockefeller Foundation and ISET, 2010):

- **Redundancy:** the various ways to accomplish tasks that are essential to system must be developed in the formulation of actions to improve resilience.
- **Flexibility:** the actions that are developed must have the flexibility because the system is also expected to accommodate condition without an error (when extreme situations do not occur). If an error occurs under extreme conditions, it is also predictable and controllable and it can be recovered quickly.
- **Reaction ability/ reorganization:** the actions that are developed are expected to support system in reshaping itself quickly in undesirable conditions.
- **Learning:** the developed actions should attempt to utilize the experiences that already exist to speed up the process of accumulation of knowledge. In other words, the proposed adaptation actions should not be untested.

Table 5.1: Resilience Criteria of Proposed Climate Change Adaptation Actions

CLIMATE ADAPTA-TION STRATEGIES	REDUNDANCY	FLEXIBILITY/ ROBUSTNESS	REORGANIZATION/ RESPONSIVENESS	LEARNING
1. Rain Harvesting	Can be done by making ponds, recharge wells, or catch water directly from the roof building.	The rainwater can be directly used to washing and toileting or through processing prior as drinking water.	Rain harvesting reduces run-off which potentially caused flooding.	There are individual initiation on rain water harvesting implementation
2. Water Saving	The reduction could also include reuse in using water and can be done in various household activities.	Water savings can be done in the dry or rainy season.	Water saving can also provide water supply in the dry season.	There have been many campaigns about water savings.

CLIMATE ADAPTA- TION STRATEGIES	REDUNDANCY	FLEXIBILITY/ ROBUSTNESS	REORGANIZATION/ RESPONSIVENESS	LEARNING
3. Purification of public wells / contaminated water sources	Purification can be done with various ways, both traditional and with implementation appropriate technology.	Filtration systems designed in order to run during floods and sea-water inundation.	inundation, purification guarantee the availability of clean water for community and reduce community fees to purchase clean water.	Purification has been applied, for example, in Aceh
4. Seawater desalination	Desalination is conducted in emergency situation only, especially when flooding occurs.	Desalination facilities are designed with mobile concept to reach flooding areas.	In emergency case, seawater desalination will guarantee availability clean water for flooding victims.	Desalination projects has been implemented in in Aceh and Bali
5. Sea wall		Sea dike will also serve as the north outer ring road of Semarang City	Sea dikes can overcome SLR at the most extreme level	It has been implemented in several other countries, such as the Netherlands and South Korea.
6. Channels belt network		Can be designed to accommodate rain-water runoff in extreme conditions, the volume channels can be design to consider extreme rainfall conditions.	Could reduce the pressure of flooding in the central part of Semarang City	It was pointed out in the drainage master-plan of Semarang. It has been implemented in some part of Semarang at small scale.
7. Neighborhood Drainage System		Can be designed to accommodate precipitation runoff in extreme conditions. The drainage design such as volume and materials may consider availability material at the local level.	Could reduce the pressure flooding in the central part of Semarang City, especially in neighborhood settlements. It can improve the quality of public health.	It has been implemented in some parts of the city at small scale, such as KIP.
8. Flooding Shelter	Should be designed with minimum elevation which higher than flooding level at the most extreme rainfall.	The construction of flooding shelter is allocated to settlement centers with time and distance consideration. The shelter can be a new building or it just integrated its function with others available building.	Community resilience increase when extreme rainfall and the failure of drainage system occurs.	The victims of flood disaster often evacuate their self independently to higher locations used to public building close to their home such as mosques, churchs, and schools.

CLIMATE ADAPTA-TION STRATEGIES	REDUNDANCY	FLEXIBILITY/ ROBUSTNESS	REORGANIZATION/ RESPONSIVENESS	LEARNING
9. Upstream Conser-vation of Jatibarang Dam	Can be done with vari-ous ways, such as agro-forestry.	Planting can be done in rainy season, and treatment will be fo-cused on dry season.	Can deliver value added economically for the community besides reduce sedimentation to Jatibarang Dam	It has been studied by Central Government, Local Government, and JICA.
10. Domestic liquid waste management to protect water re-sources	Can be done through the management liquid waste.	Can be done in individ-ual and communal scale. The design can be customized with the characteristic of problems at different locality.	Improving public health and environ-ment quality.	There are initiation activity applied by the City Government and NGOs. Citywide-sanitation masterplan is available.
11. Vegetative Treatment to address landslide in the high slope areas	There are various kinds of species (vetiver, bam-boo, crops) and planting techniques.	Planting can be done in rainy season, and treatment will be fo-cused on dry season	In addition to protect-ing homes and pre-vent the victim, this has contribution to reduce sedimentation in the urban drainage network.	There were initiation activity practised through ACCCRN's pilot projects.
12. 100 m Green belt along the shoreline in aquaculture land	There are various kinds of species and planting techniques for man-groves.	Planting can be done in rainy season, and treatment will be focused on dry season	In addition to protect-ing the fishponds, it also increases the coastal biodiversity, providing additional benefits such as for education and tour-ism.	There are many initia-tion activity applied by the City Government and NGOs
13. Diversification of marine and fisheries business and prod-ucts	Development of fisheries and marines business which is not sensitive to SLR and extreme rainfall.	Development of busi-ness and products fol-lows the demand of the markets.	Economically strengthened people who are working in marine and fisheries sector will be more stable and are able to afford individual adap-tation action if neces-sary	There are many op-tions of activities to develop this sectors.
14. Mainstreaming climate change into education curricula	Can be done through both formal and non formal education and within local government and broader community	Can be done any time. Its application could be integrated or adjusted with available education system and training.		Environmental Educa-tion programs have been practised to formal education but it is not specific about climate change.

CLIMATE ADAPTA- TION STRATEGIES	REDUNDANCY	FLEXIBILITY/ ROBUSTNESS	REORGANIZATION/ RESPONSIVENESS	LEARNING
15. The establish- ment of Center for Cities and Climate Changes	The institution organiza- tionally under local gov- ernment but it consists of city development stakeholders (govern- ment, NGOs, University, Private, Media, and Community Groups).	The organization format follow the mechanism and procedure in local government. This insti- tutional development is to increase government capacity by providing information and data base to support deci- sion making process.	This organization also provides training for government staffs or other on request.	Other similar centers are available in other cities and the centers usually based in uni- versity.
16. Involvement Pri- vate Sector in Cli- mate Adaptation Projects		Private contribution will be made specifically relevant with their inter- est.	CSR programs in pro- climate adaptation activities. Private sec- tors will be directed to have contribution to CC adaptation	Some private corpo- rations have invested their CSR to environ- mental protection projects.
17. Evaluating City Masterplan with Cli- mate Change Criteria		There are some docu- ment on CC in Sema- rang City There are enough hu- man resource capacity to deal with the evalua- tion	The output of evalua- tion can be useful for further spatial plan- ning policies. The result of evalua- tion will feed city regular evaluation on masterplan every 5 years.	There is no initiative to evaluate city master- plan with CC criteria in Indonesia, but this practice may be avail- able in other country such as India (Surat City)

5.3. Prioritization Process

Qualitative Cost-Benefit Analysis (QualBCA) is selected to conduct the process of prioritization. Before calculation of benefit and cost of activities are carried out, a qualitative description of the benefit and cost is presented in the following matrix.

Table 5.2: Costs (C) of Adaptation Actions

CLIMATE ADAPTA- TION STRATEGIES	COSTS			
	Economy	Social	Environment	Others
1. Rain Harvesting	Need a DED study, Installment, system maintenance, land acquisition for ponds system model	Negative percep- tion on rainwater quality which are assumed as dirty water Health risks as medium to mos- quitos and larvae	Landscape modi- fication for ponds system model has an effect for envi- ronment	
2. Water Saving	Installment, saving water technology	Community resis- tance to new life style		
3. Purification of public wells / con- taminated water sources	Need a DED study, Installment	Less practice from community point of view		
4. Seawater desali- nation	Machinery invest- ment, operational and maintenance, Distributor vehicle		Massive energy, produce a high level of CO2	Skillful operators
5. Sea wall	Need a DED study, Operational and maintenance, High cost investment	Sensitive to conflict over land acquisi- tion issues, loss of some people liveli- hoods	Coastal ecosys- tem degradation Sand mining in- crease to sea wall construction	People safety are threatened if there is failure Will promote develop- ment in SLR prone areas
6. Channels belt network	Need a DED study, Operational and maintenance, High cost investment	Land acquisition for development Traffic jam due to development proc- ess		Reduction of channel drainage lifetime due to sediment and garbage
7. Neighborhood Drainage System	Need a DED study, Operational and maintenance, High cost investment			Reduction of channel drainage lifetime due to sediment and garbage

CLIMATE ADAPTA- TION STRATEGIES	COSTS			
	Economy	Social	Environment	Others
8. Flooding Shelter	Need a DED study, Investment for new building, investment for building modification, land acquisition, Operational and maintenance	Perception and negative image to government (why do not solve the root of problem?)		
9. Upstream Conservation of Jatibarang Dam	Seed provision, planting, and maintenance	Need intergovernmental cooperations: beyond the authority of city government		Government's perception that conservation is economically not feasible, especially from regional income perspective
10. Domestic liquid waste management to protect water resources	Need a DED study, Installment, and maintenance	Community perception that waste water should be away from their homes		Community resistance if maintenance costs became their responsibility due to lack of understanding and economy
11. Vegetative Treatment to address landslide in the high slope areas	Seed provision, planting, fertilizing, and maintenance	Land acquisition		Time gap between planting actions and gained benefits
12. 100 m Green belt along the shoreline in aquaculture land	Land acquisition, seed provision, and maintenance	Sensitive to conflict over land acquisition issues because land ownership		Government's perception that conservation is economically not feasible, especially from regional income perspective
13. Diversification of marine and fisheries business and products	Training, Business assistance, capital support, and monitoring	Community resistance to new life style	Inappropriate type of business has a negative impact to environment	Marine and fisheries sector get less government attention
14. Mainstreaming climate change into formal education curricula	Training, curricula development, and development of learning forum	Too many subjects on formal education		
15. The establishment of Center for Cities and Climate Changes	Training, developing tools and learning media			Multi-stakeholder institutions are difficult to be funded by government

CLIMATE ADAPTA- TION STRATEGIES	COSTS			
	Economy	Social	Environment	Others
16. Involvement Private Sector in Climate Adaptation Projects	Training, seminar, and workshop	Develop dialogue forum between Private, Government, and Community.		Multi-stakeholder institutions are difficult to be funded by government
17. Evaluating City Masterplan with Climate Change Criteria	Workshop series	The result of evaluation might be difficult to be adopted due to a huge social cost		Non-physical outputs are less considered because don't have direct impact to people

Table 5.3: Benefits (B) of Adaptation Actions

CLIMATE ADAPTA- TION STRATEGIES	BENEFITS			
	Economy	Social	Environment	Others
1. Rain Harvesting	Reduce cost for water purchase Reduce economic loss from flooding	Recreation object	Reduce under-ground water exploitation	
2. Water Saving	Reduce cost for water purchase		Reduce pressure to water resources	
3. Purification of public wells / contaminated water sources	Reduce cost for water purchase	Reduce health risk due to flooding		
4. Seawater desalination	Reduce cost for water which are expensive especially on flood disaster	Provide clean water in emergency situation		
5. Sea wall	Reduce economic loss of flooding and seawater inundation Increase accessibility	Create new employments in construction phase		

CLIMATE ADAPTA- TION STRATEGIES	BENEFITS			
	Economy	Social	Environment	Others
6. Channels belt net-work	Reduce economic loss of flooding	Reduce health risk due to flooding and create new employments in construction phase		
7. Neighborhood Drainage System	Reduce economic loss of flooding and landslides	Reduce health risk due to flooding and create new employments in construction phase		
8. Flooding Shelter	Shelter can be func-tioned as public space when there is no flooding	Reduce health risk due to flooding and create new employments in construction phase	Quality of shelter is better than their houses which are flooded	
9. Upstream Conser-vation of Jatibarang Dam	Support water sources for PDAM	Create new em-ployments in planting phase and tourism activ-ity post develop-ment	Reduce sedimenta-tion into the dam and contribute to green masterplan	
10. Domestic liquid waste management to protect water re-sources	Consistency of wa-ter supply non PDAM	Waste is also community re-sponsibility Increase public health quality	Protect water re-source non PDAM	
11. Vegetative Treat-ment to address landslide in the high slope ar-eas	Reduce material loss due to land slide	Reduce the num-ber of victims	Reduce sedimenta-tion into the drain-age and contribute to green masterplan	
12. 100 m Green belt along the shoreline in aquaculture land	Protecting 1000 hectares of fish-ponds valued at 18 Billions/ year	Increase the wel-fare o coastal community Tourism and man-grove for educa-tions	Increase coastal biodiversity	
13. Diversification of marine and fisheries business and prod-ucts	Increase community income	The level of com-munity welfare at least will not de-cline		

CLIMATE ADAPTA- TION STRATEGIES	BENEFITS			
	Economy	Social	Environment	Others
14. Mainstreaming climate change into formal education curricula	Economic lost due to environmental degradation can be reduced	Increasing knowledge of people at school and university	Community-based environmentally sound activities will grow considerably	Key success for the implementation of climate adaptation program
15. The establishment of Center for Cities and Climate Changes	Availability of information, data base, and human resource to local government	The capacity of government and public will increase		Key success for the implementation of climate adaptation program
16. Involvement Private Sector in Climate Adaptation Projects	Alternative sources of climate adaptation funding are available		Environmental management activities increase which contribute to resilience	Key success for the implementation of climate adaptation program
17. Evaluating City Masterplan with Climate Change Criteria	Non-physical so it less expensive activity	The future impact of CC to society can be anticipated by spatial planning.	Environmental pressure that exacerbate the impact of CC can be identified	

5.4. Qualitative CBA and Prioritized Strategies

Qualitative CBA were chosen as a prioritization tool. The value were chosen column by column from the left (cost) to the right (benefit). Firstly, based on the qualitative description as shown by two matrices above, the CWG then decided the highest and the lowest value of strategies in each column. Although the maximum and the minimum value are 5 and 1 respectively, the value within each column is not always at maximum and minimum. After that, the rest of strategies were valued gradually between those highest and lowest. The following matrix is the result of Qualitative BCA.

Table 5.4: Qualitative CBA of Climate Adaptation Strategies

CLIMATE ADAPTATION STRATEGIES	COSTS					BENEFITS					B/C Ratio
	Economy	Social	Environ-ment	Others	Total Costs	Economy	Social	Environ-ment	Others	Total Benefits	
1. Rain Harvesting	3	1	2	1	7	5	3	5	-	13	1.86
2. Water Saving	3	3	-	-	6	4	-	4	-	8	1.33
3. Purification of public wells / contaminated water sources	3	3	-	-	6	3	3	-	-	6	1.00
4. Seawater desalination	4	-	-	4	8	2	4	-	-	6	0.75
5. Sea wall	5	3	3	4	15	5	3	-	-	8	0.53
6. Channels belt network	5	3	-	1	9	4	3	-	-	7	0.78
7. Neighborhood Drainage System	5	-	-	3	8	3	3	-	-	6	0.75
8. Flooding Shelter	4	2	-	-	6	3	4	3	-	10	1.67
9. Upstream Conservation of Jatibarang Dam	2	4	-	3	9	4	2	2	-	8	0.89
10. Domestic liquid waste management to protect water resources	4	2	-	2	8	4	3	5	-	12	1.50
11. Vegetative Treatment to address landslide in the high slope areas	3	4	-	3	10	3	3	4	-	10	1.00
12. Green belt along the shoreline in aquaculture land	3	4	-	3	10	3	2	4	-	10	1.00
13. Diversification of marine and fisheries business and products	3	4	2	3	12	3	3	4	-	10	0.83
14. Mainstreaming climate change into formal education curricula	4	4	-	-	8	3	3	3	2	11	1.38
15. The establishment of Center for Cities and Climate Changes	3	-	-	4	7	4	4	-	3	11	1.57
16. Involvement Private Sector in Climate Adaptation Projects	2	4	-	-	6	2	-	3	2	7	1.17
17. City Masterplan Evaluation-with Climate Change Criteria	1	4	-	-	5	1		3		7	1.40

Note : Assessment Range: 1 - 5

For the cost (C) 1 for inexpensive /low and 5 for the expensive/ high

For the benefit (B) 1 to benefit low/ less and 5 to high benefit/ high

From the matrix above, the priority adaptation actions in Semarang City can be formulated as follows:

- Rain Harvesting (1.86)
- Flood shelter (1.67)
- The establishment of Center for Cities and Climate Changes (1.57)
- Domestic liquid waste management to protect water resources (1.50)
- City Masterplan Evaluation with Climate Change Criteria (1.40)
- Mainstreaming climate change into formal education curricula (1.38)
- Water Saving (1.33)
- Involvement Private Sector's CSR in Climate Adaptation Projects (1.17)
- Purification of public wells / contaminated water sources (1.0)
- Vegetative treatment to address landslide in the high slope areas (1.0)
- 100 m Green belt along the shoreline in aquaculture land (1.0)
- Upstream Conservation of Jatibarang Dam (0.89)
- Diversification of marine and fisheries business and products (0.83)
- Channels belt network (0.78)
- Neighborhood drainage system (0.75)
- Seawater desalination (0.75)
- Sea wall (0.53)

6. Implementation and M&E

6.1. Implementation and Funding Priority for Actions

This CRS document is open to various parties who will implement as well as provide funding to the priority actions that have been prepared. Yet all actions and financing will be coordinated by BAPPEDA of Semarang City, assisted by the City Working Group and Technical Team on Climate Change Adaptation of Semarang. Implementation and funding priority action can therefore be carried out by various parties, both Local Government (through APBD), the central government (through APBN, ICCTF), Private Sector (through CRS Fund), NGOs, Universities, or National and international donor institutions.

Implementation of community-based approach (community-based) should remain the focus attention from the action plan. Community Involvement as it has been demonstrated in the ACCCRN's Pilot Projects have a significant influence on the success of implemented adaptation action. The involvement of community is essential especially when the contribution of community in a particular intervention will be needed during and post implementation are needed. It can be and is not limited to some activities such as incorporating community consultation, involving civil society, giving responsibility for implementation, and sharing funding and resources.

Climate change adaptation action that has been formulated basically can be divided into short, medium, and long-term intervention. Long-term intervention requires a huge financial investment and more time in make it happen. Besides, there are also adaptation actions that could be realized in a shorter period of time. The top five of prioritized actions will be the short-term category of actions that will be proposed to Rockefeller Foundation. Every action adaptation does not exclusively belong to one particular institution but it promotes collaborative action in accordance with the authority of every organization. Table below outlines priority actions for climate change adaptation in Semarang City in terms of timeframe, fund allocation , and potential collaboration execution.

Table 6.1: Matrix of prioritized Adaptation Actions Proposal to RF (Short Term - Less than 3 Years)

ADAPTATION ACTIONS	TIME FRAME	PROPOSED BUDGET	FUNDING PROPOSAL	COLLABORATING ACTORS
Rain Harvesting	30 Months	750,000 USD	Rockefeller Foundation, ISET, MercyCorps	BAPPEDA, BLH; Dinas Kesehatan; BAPERMAS, University and Research Institution, and NGOs
Flood Shelter	18 Months	210,000 USD	Rockefeller Foundation, ISET, MercyCorps	BAPPEDA, PSDA, DPU, DTK, DKPB, University and Research Institution, and NGOs
The establishment of Center for Cities and Climate Changes	12 Months	100,000 USD	Rockefeller Foundation, ISET, MercyCorps	BAPPEDA, BPS, Litbang, Bag. Hukum, University and Research Institution, and NGOs
Domestic liquid waste management to protect water resources	21 Months	230,000 USD	Rockefeller Foundation, ISET, MercyCorps	BAPPEDA, BLH, Dinas Kesehatan, DTK, University and Research Institution, and NGOs
City Masterplan Evaluation with Climate Change Criteria	12 Months	100,000 USD	Rockefeller Foundation, ISET, MercyCorps	BAPPEDA, University and Research Institution, and NGOs

Table 6.2: Medium (up to 5 years) and Long Term (Up to 10 years) of Adaptation Actions

TIME FRAME	ADAPTATION ACTIONS	FUNDING PROPOSAL	COLLABORATION AND FUNDING
Medium Term	Mainstreaming climate change into formal education curricula	APBD, ICCTF	Dinas Pendidikan, BLH; University and Research Institution
	Water Saving	APBD, ICCTF	PSDA, DPU, BAPERMAS, University and Research Institution, and NGOs

TIME FRAME	ADAPTATION ACTIONS	FUNDING PROPOSAL	COLLABORATION AND FUNDING
Medium Term	Involvement Private Sector's CSR in Climate Adaptation Projects	APBD, ICCTF	BAPPEDA, BLH, University and Research Institution, and NGOs
	Purification of public wells / contaminated water sources	APBD, ICCTF, DAK	BLH, Dinas Kesehatan, BAPERMAS
	Vegetative treatment to address landslide in the high slope areas	APBD, ICCTF, DAK	BLH, Dinas Pertanian, Dinas Pertamanan, NGOs
	100 m Green belt along the shoreline in aquaculture land	APBD, ICCTF, DAK	DKP, BLH, Dinas Pertanian, NGOs
	Upstream Conservation of Jatibarang Dam	APBD, ICCTF	Pem Provinsi (BLH, Kehutanan), BLH, Dinas Pertanian
	Diversification of marine and fisheries business and products	APBD, ICCTF, DAK	DKP, BAPERMAS, Dinas Koperasi
Long Term	Channels belt network	APBN, ICCTF	DPU Pusat, BAPPEDA, DPU, PSDA, DTKP
	Neighborhood drainage system	APBN, ICCTF	DPU Pusat, BAPPEDA, DPU, PSDA, BAPERMAS, DTKP
	Seawater desalination	APBN, ICCTF	DPU Pusat, BAPPEDA, DPU, PSDA
	Sea wall	APBN, ICCTF	DPU Pusat, BAPPEDA, DPU, PSDA, DTKP

6.2. Monitoring and Evaluation

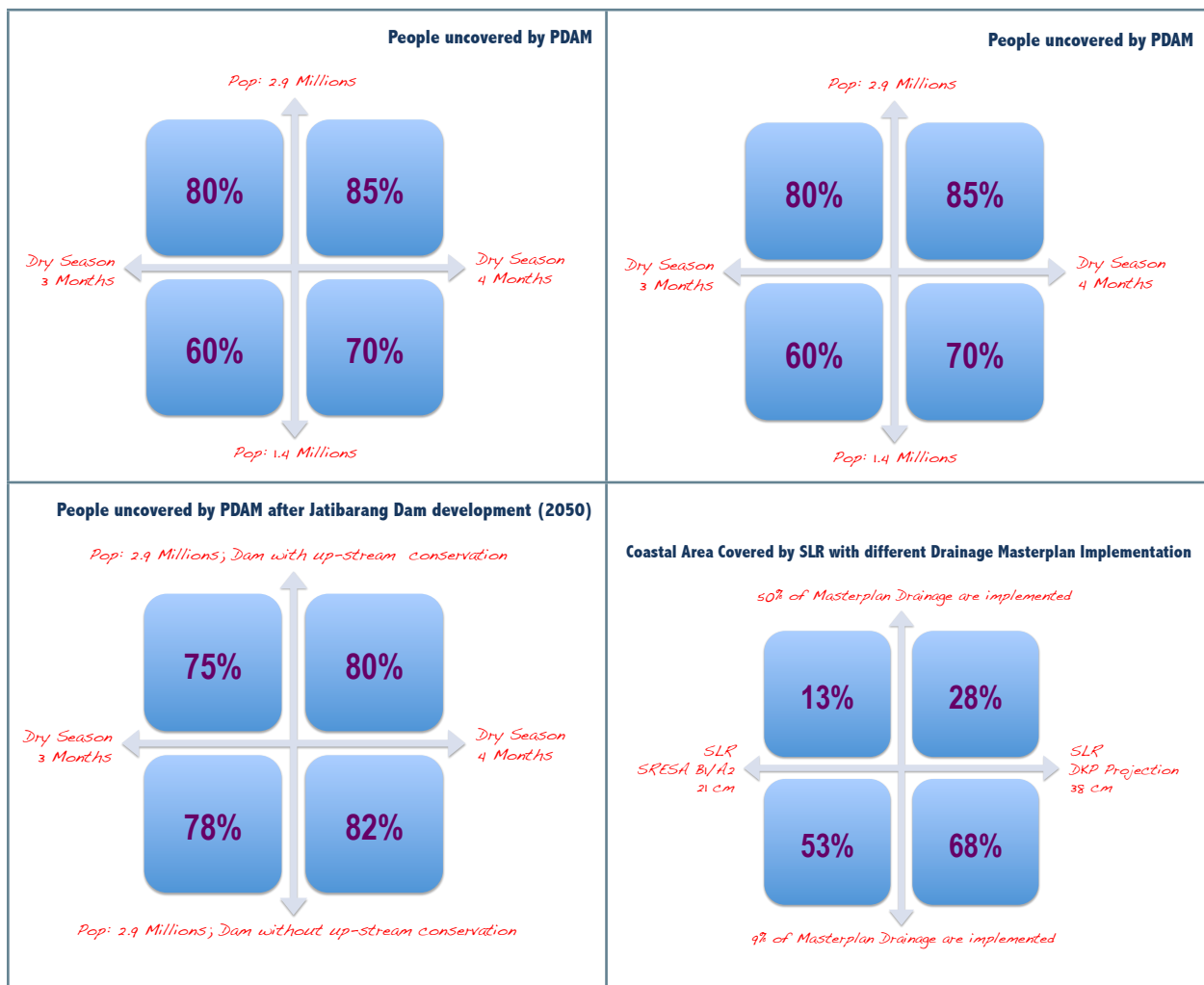
Monitoring and evaluation (M & E) of adaptation activities funded by local and state budget or fund carried out following the monitoring and evaluation process that has been defined in laws and relevant regulations. Adaptation activities funded by non-government funding such as grants from international donors, international NGOs, and private sector will adapt to the cycle of monitoring

and evaluation funders. BAPPEDA, CWG, and the Technical Team on Climate Change Adaptation Semarang City together with the initiators, implementors, and funders should prepare monitoring indicators and evaluation prior to implementation of adaptation activities. Monitoring will be performed periodically and evaluations conducted at least every year.

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Annex 1: Scenario Development





Annex 2: Concept Proposal of Prioritized Actions

SECTION 1 – TITLE, CONTACT DETAILS AND BACKGROUND

1.1 Concept title:	Water Resources Management In Dry Vulnerable Area of Semarang through Rain Harvesting Model
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SECTION 2 – OUTCOMES, APPROACH, SCOPE AND

2.1 Problem definition Why is this problem? • what is the Climate Risk? • who is vulnerable? • which Urban Systems are affected? • What is the justification? • What studies/ processes led to this being identified (e.g. Vulnerability Assessments/ Sector Studies/ SLD Meetings)	• Some of drought area (such a Mangunharjo and Kec Tembalang) have risk climate category Medium-High. In 2025 and 2050, they will expose to high risk climate category. • People who lives in drought area • It affected to pipeline or water supply system (infrastructure) and community development • VA: In drought area, people will dug well to get water. It contribute land subsidence. In some of area, they need to buy water from private provider at a costly high. • SLD 3: Rainharvesting to solve dry areas
2.2 Method What is the intended method? • How would it be done (what is the intended process) • Who would do it (project owner, partners, involved institutions)	• To identify potential water resource in semarang with mapping • To identify existing water consumption pattern and water needed projection in a future with mapping • Local Institutional dan community strengthening by training • To set participatoy planning action to cope with climate change by FGD and training • DED (detail engineering design) for new water resources utilizing through rainharvesting concept • Project Implementation • Monitoring and Evaluation
2.3 Scope What is the estimated Cost? • Provide a breakdown of costs by resource and time What is the estimated timeframe? • Is it a staged approach? • When would outcomes be achieved or outputs delivered?	Cost • Prefeasibility study : US\$ 25,000 • DED Rain harvesting models: US\$ 50,000 • Piloting and Advancing the models: US\$ 100,000 • Social marketing and awarenes: US\$ 50,000 • Rain harvesting installment: US\$ 500,000 USD • Monev: US\$ 25,000 Timeframe • Prefeasibility study: 6 Months • DED Rain harvesting models: 3 Months • Piloting and Advancing the models: 6 Months • Social marketing and awarenes: 3 Months • Rain harvesting installment: 1 Years

SECTION 3 – PRINCIPLES AND CRITERIA	
3.1 ACCCRN Principles Does the concept challenge the ACCCRN principles in any way? - Ecologically Sustainable Development - Do No Harm	- Yes, It ecological sustainability development and have no ecological impact. - This intervention doesn't need chemical or any dangerous materials that can contribute negative impact to environment. It expanse greenery to make the existing water resource sustainable.
3.2 Criteria 1: Contribution to building Urban climate change resilience (<i>Credibility</i>) Outline how the proposal meets criteria 1.	Based on VA, this area is Medium,Medium – High climate risk area and they will move to High climate risk in the future if we do nothing. This intervention will help reduce the exposure of climate risk and improve coping capacity in drought area in Semarang by potential water resource management. It will interfere infrastructure system (such as pipeline) and using water resource and also find new water resource with rainharvesting system.
3.3 Criteria 2: Impact on lives of poor and vulnerable populations (<i>Credibility</i>) Outline how the proposal meets Criteria 2.	It does impact to poor and vulnerable people in drought areas in Semarang. They will have good access of water supply, especially in dry season. The management water supply and greenery can be managed by local communities.
3.4 Criteria 10: Prospects for replication in other places (<i>Replicable and scalable</i>) Outline how the proposal meets Criteria 10.	It could be replicate to other city in regional scale and have high potencial for wide and scale up in every drought area in ACCCRN cities, especially in steep/hill areas. Rainharvesting concept is adopted from local communities, e.g, In Bandar Lampung use a tank to catch the rainfall. What we do now is how to distribute and manage the water resource and how the poor and vulnerable people have good access and can get it cheap.
3.5 Criteria 11: Ability to achieve scale (<i>Replicable and scalable</i>) Outline how the proposal meets Criteria 11.	The same as above

SECTION 1 – TITLE, CONTACT DETAILS AND BACKGROUND

1.1 Concept title:	Disaster Risk Reduction through developing shelter in flood area
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SECTION 2 – OUTCOMES, APPROACH, SCOPE AND

2.1 Problem definition

Why is this problem?

- what is the Climate Risk?
- who is vulnerable?
- which Urban Systems are affected?
- What is the justification?
- What studies/ processes led to this being identified (e.g. Vulnerability Assessments/ Sector Studies/ SLD Meetings)

- In 2050 SLR will be reach 21 – 38 cm
- Base on local government budget ability, drainage master plan will be achieved about 50% from all actions plan.
- Currently, implementation of drainage master plan is only 9% with own local government financial ability. Every year local government have ability to implement just 1% from all action plan in drainage master plan without development aid from others resource.
- Consequence of that situation is more than 7% of coastal area will getting flood in 2050.
- Now, it is about 51,000 household have flood disaster vulnerability and it will be increase until 98,000 household in 2050, or growing about 1,200 household per year with trend of drainage master plan implementation about 1% per year.
- VA and sectoral studies show flood disaster give impact to loss of assets, to damage of infrastructure and public facilities, and health problems.
- People who rich and has a family will move or evacuate to out of there are, but for poor people especially who hasn't family, so they don't have option or capacity to move from their area.
- It is needed to develop flood shelter as a evacuation place for community during flood.
- Flood shelter is expected to reduce victims of flood disaster because they have save evacuation shelter.

2.2 Method

What is the intended method?

- How would it be done (what is the intended process)
- Who would do it (project owner, partners, involved institutions)

- Feasibility Study for flood shelter in flood area in Semarang City
 - Flood risk mapping and potential location for community evacuation
 - Deciding effective and efficient for shelter
 - Developing alternative for shelter shape with new building or improving existing building (public facilities)
- DED for flood shelter development
- Shelter construction which appropriate with location characteristic and technology
- Developing disaster risk reduction system for flood disaster in Semarang, which flood shelter as a main component for flood evacuation.

2.3 Scope

What is the estimated Cost?

- Provide a breakdown of costs by resource and time
- What is the estimated timeframe?

Cost

- Feasibility study : US\$ 30,000
- DED for flood shelter development : US\$ 30,000
- Shelter construction : US\$ 100,000
- Developing disaster risk reduction system : US\$ 50,000

• Is it a staged approach? • When would outcomes be achieved or outputs delivered?	Timeframe • Feasibility study : 3 months • DED for flood shelter development : 3 months • Shelter construction : 6 months • Developing disaster risk reduction system : 6 months
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SECTION 3 – PRINCIPLES AND CRITERIA	
3.1 ACCCRN Principles Does the concept challenge the ACCCRN principles in any way? • Ecologically Sustainable Development • Do No Harm	• The function of flood shelter will be integrated with public facility, such as school, sport facility, or meeting place. From shelter management can give contribution for operation and maintenance of shelter. • Feasibility study also considers impact of environment aspect.
3.2 Criteria 1: Contribution to building Urban climate change resilience (<i>Credibility</i>) Outline how the proposal meets criteria 1.	• Shelter will reduce victim with the design consider to the most extreme of rain. • Disaster Risk Reduction system can enhance community participatory and preparedness to cope flood, so it can minimize loss caused by flood disaster.
3.3 Criteria 2: Impact on lives of poor and vulnerable populations (<i>Credibility</i>) Outline how the proposal meets Criteria 2.	• Poor population which has not family connection for evacuation become prioritize from flood shelter development because they are vulnerable group. • Impact of flood will reduce and decreasing community burden.
3.4 Criteria 10: Prospects for replication in other places (<i>Replicable and scalable</i>) Outline how the proposal meets Criteria 10.	• Flood shelter possible for replication in other place with considering climate and development scenario in the future. • Resilience strategy through developing flood shelter can be implemented in coastal cities, especially with lack of local government budget to solve the flood issues
3.5 Criteria 11: Ability to achieve scale (<i>Replicable and scalable</i>) Outline how the proposal meets Criteria 11.	• Integration flood shelter in city disaster risk reduction will help the development process, not only in city level but also for province and national level.

SECTION 1 – TITLE, CONTACT DETAILS AND BACKGROUND

1.1 Concept title:	Establishing Center for Cities and Climate Change (C4) as a center of information and capacity building
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SECTION 2 – OUTCOMES, APPROACH, SCOPE AND

2.1 Problem definition

Why is this problem?

- what is the Climate Risk?
- who is vulnerable?
- which Urban Systems are affected?
- What is the justification?
- What studies/ processes led to this being identified (e.g. Vulnerability Assessments/ Sector Studies/ SLD Meetings)

- Climate change issue is new issue, especially for local government, so just a few people have understanding with this issue.
- Although climate change impact have felt by community but it's difficult to make climate projection and estimation of impact to city development.
- Government has normative development plan system with guidance from central government. The guidance makes development plan process is easy but create boundary for local government to integrate new development issues into planning system.
- It is needed integration and sustainability efforts for integrating climate change issue into city development plan system.
- It is needed institution for providing information about city and climate change as a part from decision making process. The institution has regular program to enhance capacity building for local government related with climate change.

2.2 Method

What is the intended method?

- How would it be done (what is the intended process)
- Who would do it (project owner, partners, involved institutions)

- Training of Trainer for member C4
- Developing best practice tools, knowledge, and database
- Establishing Center for Cities and Climate Change (C4)
- Training trial and tools improvement
- Developing C4 business plan

2.3 Scope

What is the estimated Cost?

- Provide a breakdown of costs by resource and time

What is the estimated timeframe?

- Is it a staged approach?
- When would outcomes be achieved or outputs delivered?

Cost

- Training of Trainer for member C4 : US\$ 10,000
- Developing best practice tools, knowledge, and database : US\$ 50,000
- Establishing Center for Cities and Climate Change (C4) : US\$ 10,000
- Training trial and tools improvement : US\$ 15,000
- Developing C4 business plan : US\$ 15,000

Timeframe

- Training of Trainer for member C4 : 1 month
- Developing best practice tools, knowledge, and database : 6 months
- Establishing Center for Cities and Climate Change (C4) : 2 months
- Training trial and tools improvement : 1 months
- Developing C4 business plan : 2 months

SECTION 3 – PRINCIPLES AND CRITERIA	
3.1 ACCCRN Principles Does the concept challenge the ACCCRN principles in any way? - Ecologically Sustainable Development - Do No Harm	- C4 will push to enhance local government capacity for understanding and developing strategy of climate change adaptation - C4 as a part of sustainability strategy in city resilience to cope climate change after ACCRN program
3.2 Criteria 1: Contribution to building Urban climate change resilience (<i>Credibility</i>) Outline how the proposal meets criteria 1.	- C4 has capacity to research related with climate change and city development issues for giving important input to decision making process in local government. - C4 will continue to develop adaptation efforts and monitoring evaluation, for increasing city resilience to cope climate change.
3.3 Criteria 2: Impact on lives of poor and vulnerable populations (<i>Credibility</i>) Outline how the proposal meets Criteria 2.	Increasing of decision maker capacity will create pro-poor development program as a resilience strategy.
3.4 Criteria 10: Prospects for replication in other places (<i>Replicable and scalable</i>) Outline how the proposal meets Criteria 10.	Periodically, C4 hold training for local government, so the number of people who understand with climate change will increase. Distribution of knowledge to all district in Semarang will occur automatically
3.5 Criteria 11: Ability to achieve scale (<i>Replicable and scalable</i>) Outline how the proposal meets Criteria 11.	Successful and Sustainability of city to enhance resilience strategy with supported by C4 is a good practice process and it will be disseminated to vulnerable cities in climate change.

SECTION 1 – TITLE, CONTACT DETAILS AND BACKGROUND

1.1 Concept title:	Disaster Risk Reduction through developing shelter in flood area
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SECTION 2 – OUTCOMES, APPROACH, SCOPE AND

2.1 Problem definition Why is this problem? • what is the Climate Risk? • who is vulnerable? • which Urban Systems are affected? • What is the justification? • What studies/ processes led to this being identified (e.g. Vulnerability Assessments/ Sector Studies/ SLD Meetings)	• The number of household which use non-pipe water system is about 170,000 household and about 51,000 is located in coastal area which vulnerable for contamination caused by accumulation from domestic waste water in the river. • SLR will reach until 38 cm and population growth in 2050. Household with contamination of well will increase double from current. • Semarang local government in the progress to develop sanitation master plan as a respond MDGs indicator to enhance quality of sanitation. In draft of sanitation master plan explain several prioritize location for sanitation improvement to protect water resource and increasing public health. • Local government has limitation of budget to finance of domestic waste water treatment facility, cause of local government propose financing mechanism to central government. • Central government also has limitation to support all action in sanitation master plan, so it is needed other opportunity to finance this program
2.2 Method What is the intended method? • How would it be done (what is the intended process) • Who would do it (project owner, partners, involved institutions)	• Study of appropriate technology for domestic waste water treatment – Collecting best practice for community base on domestic waste water treatment – Development options of domestic waste water treatment facilities including design and construction cost estimation – Choosing appropriate or contextual technology which has resulted by Cost Benefit Analysis • Establishing community organization for waste water treatment facility management • Construction in several prioritize places • Awareness and Social Marketing
2.3 Scope What is the estimated Cost? • Provide a breakdown of costs by resource and time What is the estimated timeframe? • Is it a staged approach? • When would outcomes be achieved or outputs delivered?	Cost – Study of appropriate technology for domestic waste water treatment : US\$ 30,000 – Establishing community organization for waste water treatment facility management : US\$ 20,000 – Construction in several prioritize places : US\$ 150,000 – Awareness and Social Marketing : US\$ 30,000 Timeframe – Study of appropriate technology for domestic waste water treatment : 3 months – Establishing community organization for waste water treatment

	facility management : 6 months – Construction in several prioritize places : 6 months – Awareness and Social Marketing : 6 months
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SECTION 3 – PRINCIPLES AND CRITERIA

3.1 ACCCRN Principles Does the concept challenge the ACCCRN principles in any way? • Ecologically Sustainable Development • Do No Harm	• Domestic waste water treatment will reduce pollution in drainage system which river as end pipe. • Increasing quality of river as water resource also means enhance water supply. • Bacteria in well can be reduced with domestic waste water treatment.
3.2 Criteria 1: Contribution to building Urban climate change resilience (<i>Credibility</i>) Outline how the proposal meets criteria 1.	• Domestic waste water treatment improve sanitation system and health, also increasing city resilience in water sector, because the function of treatment to give protection for non-pipe water resource, especially well. • Increasing sanitation access, public health, and water resource availability will make strength of city system from climate change threat in the future.
3.3 Criteria 2: Impact on lives of poor and vulnerable populations (<i>Credibility</i>) Outline how the proposal meets Criteria 2.	• Bad sanitation and pollution in water resource from well will increasing community cost. • Poor population become most vulnerable group, because price of good water is more expensive compare with normal situation. • Prioritize of location for domestic waste water treatment is vulnerable group, so they can increase saving, because their cost will reduce for health and water resource allocation.
3.4 Criteria 10: Prospects for replication in other places (<i>Replicable and scalable</i>) Outline how the proposal meets Criteria 10.	• Decentralization system of domestic waste water treatment (in community level) can be replicated in other place, especially in priority area in sanitation master plan. • The goals of replication is just in management system, but for technology should consider with local situation.
3.5 Criteria 11: Ability to achieve scale (<i>Replicable and scalable</i>) Outline how the proposal meets Criteria 11.	• If community can saving because their cost will decrease after program, so this system is easier to replicate in other area.